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Biology in the Schools

APART altogether from the importance of biology as a vocational study—biology for bread—upon which the Chelmsford Report laid emphasis (Nature, Feb. 20, p. 257), there is the wider and more humane aspect of biology as an appreciation of the unity of living things, and therefore as the link between the individual and all his environment—biology for life.

Why is it that the value of this appreciation, as something that adds interest to life and has a social value as well as an intellectual, has not been sufficient to compel the inclusion of biology in the work of the schoolroom? Of its definite exclusion from the school there can be no doubt, in spite of the exceptions which emphasise the rule. Nothing could be more encouraging to the enthusiastic biologist than, say, last year's annual reports of the work done by the natural history societies at Eton, Marlborough, and a few other schools; they show a grasp of the possibilities of Nature study, an appreciation of the zest of discovering new things, and, above all, an intense keenness in this branch of study which combines learning with investigation. But these are shining lights; the vast majority of the children of Great Britain walk in biological darkness: to them the opportunity of this ever-fresh interest is denied. Of eighty-six medical students going to one of our northern universities this winter for the first time, six had learned a little botany, the others had neither botany, zoology, nor biology—a measure of the lack of biological teaching in the schools of the north, and probably the condition is repeated, though, we trust, not so decisively, in other regions of the kingdom.

One of the deciding factors in the area we refer to is the exclusion of biology and related sciences from the subjects for proficiency in which competition bursaries are awarded. The bursary competition enforces a trend of curriculum in the schools as inevitably as the scholarship examinations and awards at Oxford and Cambridge have been found by the Chelmsford Committee to enforce over-specialisation within a limited range of subjects.

A second deciding factor against biology as a school subject has been the well-entrenched position of physics and chemistry in the curriculum as representative of the observational sciences. With this may be associated the fact that it is probably easier to devise a suitable observational and experimental course with inanimate material than

with living organisms, and consequently that the proper teaching of biology is more difficult and the supply of adequately trained teachers much more restricted.

These factors lie outside the direct influence of the biologist, but the third factor which has hindered the adoption of biology in the schools lies with the biologists themselves—they have failed to give a decided lead as to what biology in the schools is to connote. It is regarded as a vague term, covering a multitude of ill-defined interests, or it is looked upon as simply a little botany plus a little zoology, each almost or altogether isolated in its own compartment. Within the last year or two, many books devised for the teaching of biology in schools have been published, and their variety in range, in subject matter, and in treatment shows how earnest an endeavour is being made to meet the demand for guidance; but at the same time it exposes the difficulty with which the willing but less experienced teacher is faced when he has to choose between so many possibilities.

We would be the last to suggest that a formal and set course in biology should be imposed upon such schools as desire the subject, for it is one of the attractive features of biology that it can and should adapt itself to the special environment of each locality. But we do say that now is the time for indicating the content of biology as best fitted for the interests of pupils in schools, and of giving a skeleton form to a subject which to many appears to be so vague as to be almost formless. Otherwise, how can it be expected that school managers or governors, unacquainted with the subject at first hand, will be able honestly to decide that here is a branch of science eminently suited and highly desirable for inclusion in the curricula of the schools under their care.

In the devising of such a course, which is to influence and appeal to a vast majority of pupils who will never enter a university or apply biology professionally, the constant aim must be biology for its interest, its outlook, and its understanding—'biology for life'.

The problem of the biology course is not confined to Great Britain. For twenty years and more the subject has been taught in the high schools of the United States of America, and so long ago as 1905 the State of New York issued its first syllabus in biology. The result was definite and encouraging, for work in the new field developed rapidly and met with unusual success. It was accompanied by an increasing desire to keep the science teaching in the schools in touch with the experience of the pupil in his own environment, and there followed the State's syllabus in general science in 1925. On this a broad foundation of scientific knowledge has been laid, and it is testimony to skilful planning that in its turn the growing emphasis upon the work in general science has demanded a further step in evolution, and that is the development of a broad course in general biology to cap the training in general science.

This new course, the substance of which has just been published,* is the result of a year and a half of consideration by a committee of science teachers and educationists selected for the purpose. It aims at rounding off the science training of the schools by bringing within the range of the many adolescents in the secondary schools the larger conceptions of biology; therefore it presupposes the existence of an earlier training of one to three years in general science. It is worth while considering the nature of this foundational training, for upon its soundness the fate of the edifice must rest.

There is universal agreement, the committee states, that the preparatory general science should deal with the environment, and should centre about the pupil as the interested focus of his or her environment. "General science should not consist of a succession of physical, chemical, biological, astronomical, and similar topics presented chiefly as a survey of these different sciences. The purpose of general science is not to acquaint the pupil with the various sciences as entities in themselves," . . . but to lead him "to investigate as an individual the various phases of the environment as they impose themselves upon him."

That seems to be a simple limitation, but it is far from being so simple as it looks; and accordingly it has been found that the teacher, perhaps following his own bent rather than the child's, perhaps because it is easier, has often strayed much further into, say, the "practical and mechanical application of physical principles and into the abstract underlying laws than is justified by the attitude of enquiry on the part of the pupil". Nevertheless, the rule is that general science in its early stages should deal with immediate environment, and that every lesson should start off from the outlook of the pupil, with all its limitations and immaturities—that is sound teaching, which should lead the pupil gently into varied fields of chemistry, physics, and simple biology.

* Tentative Syllabus in General Biology, published by the University of the State of New York: Albany, 1931. Pp. 62.

On ground thus prepared, the course of general biology is to be laid. It opens and it closes with man in the centre of the picture, played upon by, and in turn playing upon, his environment. The reason for the prominence given to human relations is that studies organised with their focus upon humanity will prove to be psychologically most interesting to the pupils. We do not feel convinced that the insistence at this stage upon the dominance of human contacts is essential, since the interest of the majority of pupils at the age contemplated is easily held by the study of any living thing. But few will cavil at the guiding principles of interest and largest social value which have determined the actual selection and arrangement of the content of the course, or at the endeavour of the committee to arrange the material in a sequence of "dependent continuity and ascending difficulty".

The programme for the course of general biology falls into four sections, divided into two parts—apparently for the convenience of the teaching year, for there is no real discontinuity between the two. The first section deals with "man's place in the world of living things", and the breadth of the treatment is indicated, but only roughly, by the three themes (each to occupy about three weeks of school time) round about which the lessons are grouped—"Man is one species among millions of diverse species"; "There is unity among all living things"; "Living things and their environment are constantly changing". From simple observation, comparison, and identification of types of plants and animals, and the recognition of diversity of form, the pupil is led to inquire into the significance of similarities and differences; and having associated changes in environment with changes in organisms, he is drawn by inductive methods to the acceptance of evolution as the simplest explanation of these phenomena.

"Self-preservation among living things" is the general subject of the second section, with three supporting themes—"All living things have the same problems"; "Living things bear different nutritional relations to their environment"; and "Living things have to relate themselves to their environment". The section begins with a study of the activities of single-celled organisms, and of the specialisation which these activities and their associated structures undergo in multi-cellular organisms; nutritional activities are selected for special discussion; and this leads to consideration of the contacts with environment made by the organism through sensation and response.

The topic of self-preservation is followed, in section three, by that of "Race-preservation among living things", and this gives opportunity for a comparative study of reproductive methods, leading to consideration of the cell-basis of reproduction and so to the cell in heredity, to the outlines of plant and animal breeding, and of inheritance in mankind.

In the final section, entitled "Man's increasing control over his environment and over himself", a wide range of possibilities lies before the teacher, for there must be considered typical ways in which environment is 'improved', say, by cultivation and by warfare against other organisms which are inimical to human welfare, and so to the balance of Nature and its unstable equilibrium. Last of all is traced the progress of man as a biological phenomenon, with a unique and accumulating social heritage, and a slow development from the eolith-maker to the time when the domestication of animals hastened the pace towards the scientific age, at the beginning of which we stand to-day.

In the consideration of this ambitious scheme of biological teaching for the secondary school, several important facts must be borne in mind. In the first place, the syllabus, which in the above summary must appear to be despairingly vague to the teacher who longs for a prescribed course of details, has been deliberately denuded of factual content, so that the teacher himself, keeping in view the emphasis upon great biological truths, may adapt the lessons to the particular needs of the urban or rural district in which he is placed. Many hints as to possible modes of treatment are given in the 62 pages of the "Syllabus". In the second place, the syllabus does not stand by itself, but is correlated with an earlier body of general scientific knowledge, and the general biology course is to be succeeded by detailed work in the sciences of chemistry and physics. In the third place, the syllabus is regarded as suggestive rather than final, and it is accompanied by a request to teachers for constructive criticism.

Even before the syllabus meets the test of actual trial, however, it will be recognised that the Committee has done a useful work in emphasising the close relationship between biology and the social sciences, and in making a determined step towards the creation of a co-ordinated programme of science tuition which will endow pupils about to leave the upper schools with the broadest values likely to be obtained by the application of the scientific method. J. R.

Can Nature be Explained?

Mind and Matter. The first of two volumes based on the Gifford Lectures delivered in the University of Edinburgh in 1919 and 1921. By Prof. G. F. Stout. Pp. xiv + 326. (Cambridge: At the University Press, 1931.) 12*s.* 6*d.* net.

PROF. STOUT writes in a rather antiquated philosophical dialect which makes it difficult in many places for a reviewer by about half a century his junior to be sure exactly what he means, and still more difficult to separate his main argument from incidentals. So far as I understand it, Prof. Stout's book is an attempt to provide a theory of the relation between perceiving minds and physical objects which shall not violate common sense, as he considers, and I think rightly, that it is violated by two of the most notable types of theory; both by what Prof. Moore has called the *Mill-Russell Type*, which minimises or eliminates unperceived physical events; and by the Cartesian type of theory, according to which percepts are only representations or reflections of physical events.

The Mill-Russell type of theory regards physical objects as sets of actual and possible sense-data; to say that a possible sense-datum exists simply means that had there been an observer at a certain place and time, where and when in fact there was none, he would have observed a certain kind of sense-datum. But according to common sense this sort of hypothetical proposition is true, and can only be true because there is a physical object which the supposed observer would have perceived, and which existed although at the time in question no one perceived it. According to the Cartesian type of theory, sense-data are events which represent and are caused by physical objects, but are not parts or aspects of them, and it is with sense-data alone, and not with physical objects, that we are acquainted, as this phrase was used by Lord Russell in "The Problems of Philosophy". But the view of common sense is undoubtedly that when we perceive physical objects we are in some sort of sense in contact with them, and not merely in contact with some medium between them and ourselves.

Prof. Stout begins the construction of a more congenial theory by an account of what he calls *the animism of common sense.* It appears to him, as it has to other philosophers, that our understanding of physical processes is increased by the organic sensations which inform us about our own bodies. There are at least two distinct ways in which this suggestion can be applied. If, for example, I support a heavy object in my hand, I have an experience which may be called a feeling of weight or pressure; it may then be said that the object of my feeling is characterised by a certain quality which I shall call strain. Now, if I watch a parcel being weighed on a spring balance, as the spring is compressed it is possible that it is characterised by a quality similar to this quality of strain—of course without the accompaniment of anything comparable to my experiencing of the strain. I do not see conclusive reasons for rejecting this form of animistic explanation. But on the other hand it may be thought, as Leibniz appears to have thought, that while we understand how our own actions take place, because our knowledge of them comes as it were from the inside, we cannot understand how any action takes place which is not that of a living organism. Thus we can only understand what happens when the parcel rests on the balance if we suppose that as the parcel descends the spring spontaneously contracts to make way for it, like a dog shrinking before a blow.

Now, so far as I can see, though Prof. Stout does not actually assert that this sort of view of Nature is true, he does ascribe it to common sense, as the champion of which he appears. But I think it is clear that common sense, on the contrary, makes a very definite distinction between mechanical and vital occurrences, and would consider that when, for example, the dog shrinks from his master's raised hand, he is in some sense behaving vitally in order that he shall not be subject to a certain kind of mechanical occurrence. I think it is clear also, quite apart from the question whether we do in any proper sense understand our own actions better than we understand mechanical events, that the alleged fact that we can only understand these mechanical events by interpreting them animistically is no ground for thinking the animistic interpretation true.

After a long consideration of previous psycho-physical theories, Prof. Stout goes on to state his own view of perception. His fundamental contention is that "physical existence which is immediately known is never actually experienced as sensations and feelings are"; "we know immediately and not by inference the actual existence of what is not actually experienced"; and he develops this by saying that "when I try to fix attention on a sensum or feeling as such . . . I can only distinguish it within a context [which] always includes real existences which are not being actually experienced". From the passage which I have quoted last, it appears as though the things which Prof. Stout refers to as immediately known though not

experienced are such things as peripheral sight-data which are not being attended to. But whether or not he refers to events of that sort, he certainly does refer to physical objects. He asserts then that physical objects are not actually experienced; I think it is quite clear that this means that physical objects are not sense-data or constructions from sense-data; and he asserts that they are nevertheless in some sense or other immediately known. Obviously this cannot mean that we know them by acquaintance, as that phrase is defined in "The Problems of Philosophy", for if we did it would follow that we experience them. Prof. Stout elucidates his use of the phrase *immediately known* by analogy with memory. In his meaning of the phrase, when I remember my last visit to the dentist I immediately know that visit, although I am not experiencing it. Now it is clear that when this memory is before my mind I know and am aware of the fact that I did visit the dentist at a certain time, and this may be what Prof. Stout would understand by the statement that I immediately know the visit. If so, to say that I immediately know a physical object presumably means that I know and am aware of the fact that a certain physical object is in a certain place. It may well be true that I sometimes know and am aware of facts like this, even if physical objects are not composed of or constructed from sense-data. But is it a novel truth?

Prof. Stout's final account of the relations between physical objects and sense-data is that "the sensory continua of individuals are parts of a world-continuum . . . having no independent being of their own apart from it". The causes of changes in my sense-field are "changes within the world-continuum". This appears to mean either that the world consists of individual minds and their sense-fields, or that it consists of these and of sensibilia which do not occur in anyone's sense-field; yet I do not think that Prof. Stout would accept either of these alternatives. A psycho-physical theory based on the former alternative would have to be a sort of monadism, such that the *changes in the world-continuum* which determine changes among my sense-data would be changes in other monads. The latter alternative is a form of the Mill-Russell theory. But Prof. Stout has explicitly rejected monadism just as much as the Mill-Russell theory on the ground of repugnance to common sense, and I therefore do not see how his final solution is to be reconciled with the common sense he has set out to defend.

AUSTIN DUNCAN-JONES.

Colour Standardisation

Colour Science: a Handbook for Advanced Students in Schools, Colleges and the various Arts, Crafts and Industries depending on the use of Colour. By Dr. Wilhelm Ostwald. Part 1: *Colour Theory and Colour Standardisation.* Authorised translation, with an Introduction and Notes, by J. Scott Taylor. Pp. xviii + 141 + 13 plates. (London: Winsor and Newton, Ltd., 1931.) 15*s*.

EXCEPT for a historical résumé of the contributions of Newton, Goethe, Schopenhauer, Helmholtz, Young, Maxwell, and Hering, and short descriptions of the tentative efforts at colour arrangement made by other investigators of the eighteenth and nineteenth centuries, this book is purely an exposition of the author's own views on the subject of colour standardisation, and an introduction to his own system. The student of such matters who approaches them through the medium of this book will unquestionably conclude that no one, excepting Ostwald, has paid any attention to them since the days of these early pioneers, and that it is only with the advent of Ostwald's system that colour measurement has become *possible*. This is explicitly stated (pp. xiii, 32, and 69), and is implied throughout the whole book.

There are no references to the intensive study which has been devoted to such problems in the United States, Great Britain, and the author's own country within the last twenty years, and no indication is given of the principles which form the common basis of the systems officially adopted at such institutions as the U.S. Bureau of Standards, the National Physical Laboratory, and the Physikalische Technische Reichsanstalt, and employed, with or without superficial variations in minor details, by numerous technical workers in the United States, Great Britain, Germany, and other countries.

It will be evident, therefore, that this book, while it will doubtless be read with interest by those who are already familiar with colorimetric developments but may have found difficulty in following Ostwald's work in German, will give a misleading impression to any beginners who may be induced to regard it as a textbook on colorimetric science.

Prof. Ostwald's method of presentation is not likely to appeal to the scientific reader. His style is that of a schoolmaster giving an account of matters concerning which there can be no dispute; it is dogmatic, and therefore unsuitable, where, as in the present case, he is discussing matters on which he is at variance with contemporary workers in the same field. Nowhere is any

experimental evidence offered with sufficient technical detail to enable the reader to appraise its value or check it in his own laboratory. We have to be content with the statement that so and so "withstands this test perfectly" (p. 80), or that "I have found the expected agreement" (p. 138).

Only a brief reference to the main features of Ostwald's theory of colour standardisation is here possible. One fundamental fallacy underlies the whole theory and is responsible for all the special features which distinguish his system. Ostwald claims to have discarded the physical characteristics of the *stimulus*, such as frequency, energy, and luminosity, and to have substituted for these, as the basis of his system of numerical colour specification, the properties of visual *sensations*, including their æsthetic relations, harmonies, etc. In doing so he overlooks the essential nature of every process of *measurement*, and the mathetic impossibility of obtaining by any such process quantitative relations between non-physical things, or between physical things on one hand and non-physical things on the other.

It is now well recognised by every physicist who has given attention to visual problems that every 'colour equation' or 'brightness equation', in whatever nomenclature it is disguised, is a *stimulus* relation. All the experimentally determinable quantities which appear in it are stimulus quantities and cannot be anything else. Ostwald takes as his fundamental relation for the colours of all objects under the same intensity of incident illumination the equation:

$$C + W + B = 1,$$

where C is what he terms the 'full colour' which determines the hue, W is white, and B is black. He conceives this to be an analysis of the colour *sensation*. But, whenever we insert *measured* quantities for C and W, the equation necessarily becomes an analysis of the *stimulus*. The term in B then becomes meaningless, since black has no stimulus value and $(C + W)/1$ is simply the fraction of the incident light which is reflected (or transmitted) by the object. It is equivalent, if the units are properly chosen, to what in present English nomenclature is termed the 'brightness factor' of the specimen. It is a mere photometric ratio of two stimulus intensities. The ratio $C/(C + W)$ is also a stimulus ratio, and is of the same nature as the ratio which is variously termed, in English literature, 'purity' or 'colorimetric saturation'. The principle is not affected by the fact that instead of employing the easily definable and easily reproducible homogeneous spectral radiations as the hueful constituents of the system, Ostwald employs the ill-defined and incompletely saturated 'full colours' of his colour circle. If these so-called 'full colours' were properly and unambiguously defined in stimulus terms, an Ostwald specification would be immediately convertible to a specification in terms of dominant wave-length, colorimetric saturation, and brightness factor.

In principle, therefore, the system of colorimetrics embodied in Ostwald's fundamental equation is not new. It follows at once from the application of Newton's law of colour (stimulus) mixture to the Maxwell triangle, and was propounded by Helmholtz in a proposition quoted on p. 22 of the present book, and condemned by Ostwald as having been "the cause of protracted delay in the development of colour science".

The apparent differences of Ostwald's system from previous systems embodying the same principle are all non-essential. The psychological and æsthetic considerations which lead him to base his numerical scales on geometric progressions and give rise to the distinctive features of his nomenclature have no relevance to colour *measurement*, in which stimulus quantities alone can enter. They merely result in confusion of thought and in the absence of proper definition which necessarily results from the apparent determination to avoid calling a spade a spade.

It does not follow, however, that because Ostwald's system of colour specification is merely a disguised form of a well-known and long-established system, which, incidentally, follows directly from the more fundamental 'trichromatic' system, that the practical results obtained by users of Ostwald's methods are sound. It is true that if apparatus were devised to obtain, correctly, the various elements of the Ostwald specification, a perfectly sound and self-consistent system, directly relatable to colorimetric fundamentals, would result; although, in practice, the introduction of the so-called full colours instead of simple homogeneous constituents merely leads to inconvenience. The methods of measurement actually employed by Ostwald are not described in volume 1, and so do not properly come within the scope of this review; but in view of the fact that some of the theoretical conclusions advanced in the present volume are presumably based on such measurements, it is necessary to point out that Ostwald's metrical technique, in which the quantities C and W are evaluated by methods of filter photometry, does not in fact give these quantities, but merely an approximation thereto, of more or less crudity de-

pending on the nature of the absorption curve of the specimen under test. This failure of the experimental technique to give a true representation of the fundamental equation is no doubt the cause of these inconsistencies which have been found by those who have carried out proper colorimetric analysis of the Ostwald standards. J. GUILD.

Amalie Dietrich, Naturalist

The Hard Road: the Life Story of Amalie Dietrich, Naturalist, 1821–1891. By her daughter, Charitas Bischoff. Pp. 317. (London: Martin Hopkinson, Ltd., 1931.) 10*s.* 6*d.* net.

THIS is an intensely human document, not a book of natural history. Amalie Dietrich was the daughter of a leather worker, of Siebenlehn, in Saxony. She was almost uneducated when she married a 'naturalist', an affair of temporary passion on his part. She became his slave, educating herself, learning to collect and mount plants and animals, carting his vasculum and baskets. He lived in the clouds, mostly of his own conceit, happy over a new plant which perchance would be called after him. Excursions were made all summer, and in the winter they took the road, visiting town after town, finding out from chemists the addresses of naturalists who might buy their collections. Later Amalie writes: "I used to trail all over the country with dear faithful Hector [the dog]! The cart was so heavy and the road often so bad, we had to endure hunger, frost and heat, and ceaseless crushing anxiety as to our daily bread, and you [her daughter]." It is a vivid picture of the collecting craze and of the rivalry that arose out of the work of Linnæus, especially keen in the various State centres of Germany.

This life could not last, and the errant fancy of Wilhelm, her husband, took flight. We need not follow the next years, after which, her reputation as a collector established, she took service under Cæsar Godeffroy. The romance of the Godeffroy Museum, now the property of the City of Hamburg, is well known. Every skipper of this merchant prince was ordered to bring back curiosities from the domains of this "king of the South Seas", whose influence permeated every island group in the Pacific where coconuts were grown, and every beachcomber looked forward to the arrival of his ships. Indeed, in the 'nineties, the writer had more inquiries about Godeffroy than the almost legendary Queen Victoria, his supposed rival. He financed Amalie Dietrich for ten years during which she collected the Queensland region from Brisbane to Torres Straits and also Tonga. Plants were her speciality, but insects, mammals, birds, native weapons, skulls, and indeed everything, were sent home properly labelled. She loved the collecting and the hard work, the handling and labelling of her specimens, perhaps to-day the most valuable collections secured by any single person.

On her return home, Godeffroy, with characteristic generosity, for thirteen years gave her rooms in his house, close to the beloved museum, and after his death the municipality of Hamburg looked after her. She was still a peasant at heart and in her ways, but she was a genius in her line; and Germany has perhaps a better way of appreciating and making happy such originals as she was. He who sets out to collect can learn much from her story; collecting is not the mere accumulation of specimens, but an art. J. S. G.

Short Reviews

Contraception (Birth Control): its Theory, History, and Practice; a Manual for the Medical and Legal Professions. By Dr. Marie Carmichael Stopes. New and enlarged edition. Pp. xxvii + 487 + 10 plates. (London: G. P. Putnam's Sons, 1931.) 15*s.* net.

IN this new edition of Dr. Marie Stopes's treatise on the control of conception it has been possible to exclude a considerable amount of matter of the nature of 'propaganda' which appeared in earlier editions, and to extend those portions dealing with methods and technique, and so to render the book of more service to the medical practitioner. Needless to say, the book deals very fully with all aspects of the subject, and nothing essential seems to have been omitted. It is of interest to find that the records of birth-control clinics so far available establish the fact that the simplest and cheapest technique of all (a rubber cap associated with a chemical spermaticide) yields the highest degree of security and reliability.

Dr. Stopes naturally deals at length with arguments advanced against the use of birth-control, but we fear she is as one crying in the wilderness, for there will always be persons or bodies who will oppose it on medical or moral grounds. We believe that the argument of opponents respecting the physical harmfulness to the woman of contraceptive measures has been much exaggerated, and that simple measures like those advocated may be pursued without detriment. As regards abstinence versus contraception for the limitation of families, it may be said that in general for a normal couple living together in the intimacy of married life abstention appears to have a very deleterious effect. The subject has, however, a much wider issue than that of the individual, for many regard the artificial limitation of populations as a measure upon which the salvation of the human race in the future may largely depend. A fuller and wider knowledge of

contraception and all that it may mean for the individual and the race is desirable among medical men that it may be judiciously passed on by them to the general public, and this new edition of Dr. Marie Stopes's book will be found to give all the information that may be required.

Board of Education: Science Museum. Henson and Stringfellow, their Work in Aeronautics: the History of a Stage in the Development of Mechanical Flight, 1840–1868. By M. J. B. Davy. Pp. 115 + 25 plates. (London: H.M. Stationery Office, 1931.) 5*s.* net.

THE experiments of Henson and Stringfellow on mechanical flight were of an exceptionally interesting character, and now that much of their apparatus has been secured for the nation, and placed on exhibition in the Science Museum at South Kensington, it is only fit that whatever is known of the men and their activities should be placed on record. Neither of them was included in the "Dictionary of National Biography", and this record, prepared by Mr. Davy and fully documented, will be welcomed by every student of aeronautics wishing to know something of the history of the subject.

Henson was born in 1805 and died in 1888, while Stringfellow was born in 1799 and died in 1883. How they came to collaborate, what experiments they carried out together or separately, and what they actually achieved, are all well told, and the illustrations include not only photographs of their model machines, but also drawings from which it would be possible to construct replicas. If the Aerial Transit Company, launched in 1844 to utilise an invention "which if ultimately successful will be without parallel even in the age which introduced to the world the wonderful effects of gas and of steam", was mainly productive in providing material for the caricaturists, its failure does not detract from the merits of the inventors, whose ingenious and persevering efforts brought them very near to a success which, to-day, we know to have been beyond their reach.

A Textbook of Physiology. By Prof. William D. Zoethout. Fourth edition. Pp. 724. (London: Henry Kimpton, 1931.) 18*s.* net.

THE third edition of this "Textbook of Physiology" was reviewed in these columns only three years ago (NATURE, vol. 123, p. 379; 1929). The fact that a new edition has been called for so soon indicates that the work fills a definite gap in physiological literature. It is a medium-sized textbook, shorter than the number of pages might indicate owing to the size and clearness of the printing. It is intended to present the main facts of physiology in adequate detail, but makes no claim to supplant the larger works. A few references to monographs or reviews are given in each chapter, so that the reader who is interested is put on the track of the literature of different branches of the subject.

The author has taken the opportunity to revise the work throughout, especially the sections dealing with the central nervous system, metabolism, and the endocrine glands; in addition, a number of new graphs, diagrams, and anatomical illustrations have been added. The application of the facts of physiology to the maintenance of health in man is frequently emphasised. Some paragraphs referring to certain human ailments serve to link the subject with medicine, so that the medical student can realise the importance of his study of physiology for his later clinical work. The book may be recommended to medical students and to others commencing the study of physiology.

Heredity. By Prof. A. Franklin Shull. (McGraw-Hill Publications in the Zoölogical Sciences.) Second edition. Pp. xv + 345. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1931.) 15*s.* net.

PROF. SHULL'S textbook presents the essentials of Mendelian heredity with special reference to human problems. It is intended for students, the majority of whom have no biological training and do not intend to specialise in that science, reading genetics as part of a general education. The second edition is bulkier than the first (1926), owing mainly to expansion of the chapters dealing with human inheritance. The absence of any mention of natural selection, either in the chapter on the mechanism of evolution or in the index, is surprising; for the chief problem confronting the Mendelian who sets out to explain evolution is to show how progressive modification of a race, continuing through vast numbers of generations, can be brought about by random mutation, and here the hypothesis of natural selection offers at least a plausible explanation. The recent discussions by Haldane, Fisher, Hogben, and others of the effect of selection on Mendelian populations should receive attention in this context, and would also illuminate the chapter on eugenics. G. P. W.

Die Gift- und Arzneipflanzen von Mitteleuropa: mit besonderer Berücksichtigung ihrer Wirkungen. Von Dr. Otto Gessner. Pp. viii + 348 + 128 Tafeln. (Heidelberg: Karl Winters Universitätsbuchhandlung, 1931.) 9·50 gold marks.

THIS very useful handbook of poisonous and medicinal plants differs from most other books on a similar subject in the arrangement, the balance of matter in the text, and the illustrations. The plants discussed are not arranged according to one of the well-known taxonomic schemes, but under headings of the chief active chemical constituents, such as alkaloids, glucosides, tannins, and etherial oils. Each group is prefaced by a lucid summary of its more important chemical features. Most of the text is occupied by accounts of the species native to or cultivated in central Europe and used in pharmacy or known to be, or suspected of being, poisonous. Under each species, besides a brief botanical description, the active principles are given, and usually a full account of the pharmacology, including symptoms, physiological reactions, and treatment. The work is accompanied by 128 coloured plates, of varying merit, but the majority botanically excellent and several æsthetically noteworthy, and a long index. W. B. T.

Origin of the Gamma Rays *

By the Right Hon. LORD RUTHERFORD, O.M., F.R.S.

IT has long been known that some of the radio-elements emit a penetrating type of X-rays known as the gamma rays. It is clear that these radiations arising from the nucleus of the radioactive atom represent in a sense some of the characteristic modes of vibration of the nuclear structure. The wave-length and quantum energy of many of the stronger lines in the complicated gamma ray spectrum have been determined by different methods, with concordant results. It has been difficult to determine with certainty the origin of this radiation. It was at first supposed that it must arise from the motions of electrons in the nucleus, but in recent years there has been a growing belief that the radiation is connected with the transition of an α-particle or proton which forms part of the nuclear structure.

It is not an easy matter to distinguish between the various hypotheses, since very little is known about the detailed structure of the nucleus. Fortunately, during the last two years, two different methods of attack on this problem have been developed. The first depends on an analysis of the groups of long-range α-particles which are emitted in small numbers from radium-*C* and thorium-*C*, and the other the analysis of the fine structure shown in the emission of α-rays from certain bodies. It may be supposed that the emission of a β-particle during a transformation causes a violent disturbance in the resulting nucleus, some of the constituent α-particles being raised to a much higher level of energy than the normal. These α-particles are unstable and after a very short interval fall back to the normal level, emitting their surplus energy in the form of a gamma ray of definite frequency. According to the ideas of wave mechanics, in this short interval there is a small chance that some of the α-particles in the higher levels can escape from the nucleus.

On these views, the escaping α-particles represent the long range α-particles observed, and the energy of the α-particles gives the value of the energy level in the nucleus which it occupied before its escape. Following out these ideas, the long range α-particles which escape from radium-*C* have been carefully analysed, using the new electrical methods of counting α-particles.

Nine distinct groups of particles were observed, and the energies of α-particles forming each group were determined. The differences of energy between the various groups were found to be closely connected with the energy of some of the most prominent γ-rays in the spectrum, and, in general, the experiments gave strong evidence that the γ-rays had their origin in the transition of one or more α-particles in an excited nucleus.

It has generally been supposed that in a radioactive transformation all the α-particles are expelled with identical speed. This is certainly the case for most bodies, but Rosenblum found that the element thorium-*C* emitted not one but five distinct groups of α-particles. This discovery was made possible by making use of the great Paris electromagnet in order to bend the α-particles into a semicircle. Gamow pointed out that the appearance of such a 'fine structure' in the α-ray emission should be accompanied by the liberation of γ-rays.

Owing to certain experimental difficulties, it is not easy to obtain a clear-cut decision on this point. Ellis concludes from his experiments that Gamow's view is correct, but Meitner, from similar experiments, reached an opposite conclusion. In view of this difference of opinion, I have made in conjunction with Mr. Bowden some experiments to throw light on this problem in another way. Recently Lewis and Wynn Williams found that the actinium emanation emitted two distinct groups of α-particles differing in energy by about 340,000 volts. It was seen that this observation offered a simple method of testing the theory of Gamow. The emanation was carried by a current of air into a separate chamber and the emission of β- and γ-rays tested directly. It was found that the transformation of the emanation was accompanied by a weak β-radiation and a strong γ-radiation. The experimental results were in good accord with the theory, and thus showed that the presence of a 'fine structure' in the α-ray emission is accompanied by the emission of γ-rays. At the same time, the results afford strong corroborative evidence that the γ-rays have their origin in the transitions of an α-particle in an excited nucleus.

It is of interest to consider how far these views can be carried into the region of the artificial disintegration of the elements resulting from the bombardment of certain light elements by α-particles. In some of these disintegrations it is necessary to assume that the α-particle can be captured in different energy levels, and that a γ-radiation is emitted as a result of the transition between the two levels. Penetrating radiations have, in fact, been observed in several cases when light elements are bombarded by α-particles. Some of these cases are of peculiar interest.

RADIATION FROM BERYLLIUM AND THE NEUTRON

In examining the artificial disintegration of light elements under the action of α-rays, Bothe and Becker in 1930 noted that beryllium under α-ray bombardment did not emit protons like boron or nitrogen, but gave out a weak radiation which was more penetrating in character than the γ-rays from radium. The absorption of this radiation in its passage through matter was later examined in detail by Mme. Curie-Joliot and M. Joliot, and by Webster.

It is usual in experiments of this kind to employ active preparations of polonium on a metal disc as a source of α-rays. This source is very convenient

* Substance of the Friday evening discourse before the Royal Institution on March 18.

for the purpose, as the results are not obscured by the presence of β- and γ-rays which are so freely emitted from other α-ray sources such as radium-*C* and thorium-*C*.

In examining the absorption of this beryllium radiation by the ionisation method, Mme. Curie-Joliot and M. Joliot made the striking discovery that hydrogen material, when exposed to this radiation, emitted swift protons. In explanation, they suggested that the protons gained their energy by a radiation recoil in a process similar to the well-known Compton effect, and estimated that the quantum energy of the radiation must be of the order of 50 million electron volts.

J. Chadwick, using direct counting methods of great sensitiveness, found swift recoil atoms were liberated not only in the passage of the radiation through hydrogen, but also in other light elements, including helium, lithium, beryllium, carbon, air, and argon. In a letter in NATURE of Feb. 27, he pointed out that the results in this and other directions were difficult to reconcile with the hypothesis of a quantum of radiant energy of such high frequency. He suggested that the effects observed were not due to a γ-radiation at all, but to the liberation from the bombarded beryllium of a stream of swift uncharged particles or ' neutrons '.

The idea of the possible existence of neutrons, that is, of a very close combination of a proton and electron to form an uncharged nuclear unit of mass nearly 1, is not new to science, but it has been very difficult to find any definite evidence of its existence. I discussed the properties of such a neutron in the Bakerian Lecture before the Royal Society in 1920, and both the late Dr. Glasson and Dr. Roberts made experiments in the Cavendish Laboratory to test whether neutrons were produced in strong electric discharge through hydrogen, but without success.

It is to be anticipated that a projected neutron would produce little, if any, ionisation in its passage through matter, and would pass freely through the outer structure of atoms. A swift neutron should, however, indicate its presence by the recoil of an atomic nucleus with which it collided. This recoiling nucleus would spend its energy of motion in ionising the gas, and should thus be readily detected by its electrical effect or by the trail of water drops it produces in a Wilson expansion chamber. In some respects, however, the effects produced by a neutron would be very similar to those due to a quantum of high-frequency radiation, and careful experiment is required to distinguish between them.

The velocity of the neutron at the moment of its liberation is estimated to be about 3×10^9 cm./sec., or about one-tenth of the velocity of light. By comparison of the velocity of recoil of different atoms, Chadwick finds that the mass of the neutron is about the same as that of the hydrogen atom. In addition, the velocity of recoil of a given atom falls off when the radiation is passed through increasing thicknesses of an absorbing material like lead. This is exactly the behaviour to be expected for the neutron, but not for a high-frequency radiation.

Very valuable information on this problem can be obtained by photographing the effects due to the passage of this new type of radiation through a Wilson expansion chamber. A number of such experiments have been made by N. Feather and P. I. Dee in the Cavendish Laboratory in association with Dr. Chadwick. For example, it is to be anticipated that the neutron would occasionally collide with the electrons in its path, and thus give rise to an electron track of maximum length corresponding to twice the velocity of the neutron. This is exactly analogous to the well-known production of δ-particles by the passage of α-particles through gases.

Several such short electron tracks have been photographed by Dee which have about the right length, and for which it is difficult to suggest any other explanation. Feather has obtained photographs of more than a hundred recoil tracks produced in an expansion chamber filled with nitrogen. He has observed another very interesting effect. In addition to the straight recoil tracks, he has obtained photographs of a number of branching tracks which indicate that the nitrogen has disintegrated in a novel way. These branch tracks are believed to be produced by the recoiling nucleus and by some particle which is ejected from the struck nucleus. The identity of this latter particle has not yet been definitely established.

It will take time to analyse the results obtained, and to examine the effects produced in other gases. The peculiar properties of the neutron allow it to approach closely, or even to enter, nuclei of high atomic number, and it will be of great interest to study the effects of such collisions. It is, however, evident that this new radiation has surprising properties, and there is every promise that it may prove an effective agent in extending our knowledge of the artificial disintegration of elements. It will, for example, be of much interest to decide whether the neutron is captured in such disintegrating collisions, or whether it merely passes through the nucleus on which it has such a catastrophic effect.

Mme. Curie-Joliot and M. Joliot and Dee have independently noted that some swift electron tracks are observed in the expansion chamber. The exact origin and nature of these particles will require careful examination. It is possible that a γ-radiation is emitted from beryllium as well as the neutron. Mme. Curie-Joliot and M. Joliot found that the radiation from boron bombarded by α-particles behaved similarly to that from beryllium. It is possible that other elements will also give rise to radiations of this kind.

Whatever may be the final explanation of the interesting facts observed, it is clear that if they are due to a quantum of radiation, we must relinquish the laws of the conservation of energy and of momentum in the production of this radiation and its inter-action with matter. If we wish to retain these laws, the neutron hypothesis seems the only alternative. In any event, it is evident that these new discoveries have opened up a new region of research which is of great interest and promise.

Index Londinensis *

WITH the issue of vol. 6 of "Iconum Botanicarum Index Londinensis" or, for short, "Index Londinensis", the publication of this great work has been completed. Notices concerning the several volumes as they appeared will be found in earlier issues of NATURE (Jan. 11 and April 5, 1930; April 18, 1931). It seems now to be the time for a comprehensive survey of the work, setting down its aims, its bearing on botany, and the development of illustration as an auxiliary for the botanical author, and, last but not least, the claims for a rational continuation of it.

When, nearly fifty years ago, Darwin provided for the publication of a catalogue of the names of the species of flowering plants, with references to their places of publication—a catalogue which has become familiarly known as the "Index Kewensis"—a step was taken which freed the taxonomist of an immense amount of labour and drudgery with one stroke. At the same time it protected him against overlapping and confusion, and guaranteed the consolidation of a widely scattered literature which before long would have become a very serious hindrance to progress. It is, in fact, difficult to visualise how botanical taxonomy could progress without such assistance as is afforded by the "Index Kewensis".

The basis of the records of this catalogue were descriptions, some complete, but many incomplete in widely varying degrees. Of these not a few were accompanied by illustrations or references to illustrations, intended to supplement the description or to support it in the most concise and comprehensive form possible by picturing the plant as a whole or essential parts of it. It is true some of these illustrations, though not indicated as such in the "Index Kewensis", were implicitly put on record by it. However, a much greater number of illustrations of the same order was contained in the pictorial literature, which under some disguise existed already or later grew up in the course of the general progress of taxonomy and its sister branches of morphology and applied botany. An attempt to catalogue the illustrations of flowering plants and vascular cryptogams was made by G. Pritzel in his invaluable "Iconum botanicarum Index locupletissimus", which appeared in 1855 and was supplemented by a second volume in 1866, but this "Index" was avowedly incomplete and for the present-day student very much out of date.

The need for a more comprehensive and up-to-date "Iconum Index" was therefore as pressing as it was undisputed. The difficulty of satisfying it was in the magnitude of the work and the expense which its execution entailed. It was evident from its compass that it could only be undertaken at one of the few great centres of taxonomic botany and on the strength of an organisation which guaranteed the maximum of completeness, and at the same time a speed of execution that prevented its becoming long out of date before it was finished, whilst the material means required for it were such as to preclude private enterprise. Only an institution wealthy, far-seeing, and generous could risk the outlay, which was bound to be unremunerative from the commercial point of view. The institution was found in the Royal Horticultural Society of London, which rose to the occasion, providing the money for the preparation of the manuscript and securing the co-operation of the delegates of the Clarendon Press, Oxford, who took upon themselves the risk of printing, whilst the Royal Botanic Gardens, Kew, afforded all the facilities at their disposal, housing the staff and granting full use of the Library. Other institutes all over the world also lent their help when occasion required.

Attention may be directed to two features of the "Index". They concern the selection of illustrations and the correlation of the records in so far as they are affected by the conflicting nomenclature, which in the past resulted from the largely ill-organised labour of the taxonomists as a body. There is clearly demonstrated an endeavour to include as many illustrations as possible, wherever they were connected with a scientifically established name, irrespective of their often disputable claim to perfection and completeness. Also homonyms of genera and species have been sorted out and an elaborate system of cross-references for synonymous genera has been introduced. Necessarily a wide field of independent investigation has to be left open to the student, but even so much has been achieved that will save time and lead to literature which otherwise might have been ignored.

The importance of adequate illustration need not be stressed. It is self-evident, and there is the less excuse for neglecting it as a corollary to description and explanation, as the methods of illustration have been much improved, multiplied, and deprived of costliness during the last half century. If it should be argued that they still add much to the expense of publication, it should also be kept in mind that the insertion of illustrations allows in many cases the cutting down of the descriptive text, and also that illustrations may, as is indeed frequently done, be loaned from other works, a practice which will be greatly facilitated by reference to the pictorial treasure-store registered in the "Index Londinensis".

Reviewing the records of the "Index", one cannot help being struck by the largely haphazard method of illustration in taxonomic works, a vast number of genera and species being still very inadequately illustrated, whilst many others are over-illustrated. With the "Index" as a readily accessible basis it may be hoped that the innumerable

* "Index Londinensis to Illustrations of Flowering Plants, Ferns and Fern Allies, being an emended and enlarged edition continued up to the end of the Year 1920 of Pritzel's Alphabetical Register of Representations of Flowering Plants and Ferns compiled from Botanical and Horticultural Publications of the XVIIIth and XIXth Centuries." Prepared under the Auspices of the Royal Horticultural Society of London at the Royal Botanic Gardens, Kew. By O. Stapf. Six vols. (Oxford: Clarendon Press; London: Oxford University Press, 1931.) 105*s.* net each volume.

gaps will now be gradually and methodically filled and redundancies avoided.

So far, "Index Londinensis" covers the period 1753–1920 (inclusive). The earlier literature has been drawn upon only in cases where post-Linnean interpretations have lifted it into the reach of scientific nomenclature. Future studies may give occasion for further additions from this, in many respects, valuable field of botany. However, the gap left by the upward limitation of the records to the year 1920 is far more serious. More than ten years of intense activity have now elapsed. When the original issue of the "Index Kewensis" was completed, its continuation by quinquennial supplements was at once insisted upon and carried out, and their discontinuation could not now be considered, and similar consideration should be given in the case of "Index Londinensis". It is already looked upon as the indispensable companion of the "Index Kewensis", and we hope it will remain so. The Royal Horticultural Society has authorised the compilation of a Supplement, intended to take in the pictorial literature for the years 1921–1935 (inclusive), and to be published by the end of 1936 or early in 1937, and it has made an initial grant for one year. The work on the supplement was begun early in 1931 and has so far resulted in a collection of more than 30,000 references, which are now accessible to the student in the Index-room of the Herbarium at Kew. It remains, therefore, to secure the guarantee of such further funds as will be required for the uninterrupted continuation of the work on the basis of, and in conformity with, the main issue, and it is most desirable that provision for this should be made without delay.

Atmospheric Pollution*

THE seventeenth report on atmospheric pollution issued by the Department for Scientific and Industrial Research records investigations made in Great Britain in the year preceding March 31, 1931. Observations show that the solid matter deposited from the air in twelve months in 42 towns ranges from 550 tons per square mile at one station in Lancashire down to 72 tons in Leicester, the average being more than 200 tons. Generally the observations show a reduction, especially in the sulphates, presumably due to industrial depression and reduced fuel consumption. In London, for some reason, this is not so, and some increases in atmospheric pollution are recorded.

Indeed, the report does not flatter London, which apparently will continue to have its fogs, and the records of suspended impurities do not support the current belief in the decline in the number of smoke fogs. Charing Cross is one of the worst spots, and the amount of smoke haze seems greatly to exceed that of many industrial centres, where the atmosphere by comparison is clean.

The most remarkable records come from Coventry, where on no single day was a smoke haze recorded. Now, Coventry is a large city, highly industrialised, and the circumstances therefore deserve close scrutiny. The Medical Officer advances several reasons to account for this. Coventry is not congested, and has rural surroundings without obstruction to hinder the scavenging action of the wind. The factories are on the outskirts and freely use electricity for power and gas for the heat treatment of metals. Thus there are few sources of industrial smoke, and no special smoke inspection is necessary. Moreover, the use of gas is almost universal in the kitchens there.

It may be urged, however, how will this help in the smoky cities where the heavy trades are practised? For these, the smoke laws have always been lenient and have made no restriction on the emission of black smoke, because of the dogma that steel must be heated in a smoky furnace atmosphere. This should no longer be accepted without challenge. After protracted investigation of the influence of atmosphere on the scaling of steel, Prof. J. W. Cobb and his collaborators at the University of Leeds could not find evidence to support this belief. Indeed, no fuel seems more suitable in this respect for heating steel than a producer gas made from a high temperature coke. Experienced men in the Sheffield trades are not disposed to contest this conclusion, which, if valid, destroys the 'divine right' of the heavy trades to use smoky furnaces, however convenient it may be to do so in practice. Again, steel makers have no objection to using coal gas if the price is right. Any doubt about this is dispelled by a journey up the Ruhr Valley in Germany, where coke oven gas is freely used. The comparative cleanness of the atmosphere and the towns there makes a remarkable contrast with corresponding areas in England.

An observant traveller going north from Sheffield may first be shocked by the gross atmospheric pollution he will observe, and in a few minutes amazed by the sight of great flares of coke oven gas — a smokeless fuel — burning to waste. True, this is in process of remedy by the organisation of the South Yorkshire Gas Grid, which now has legal sanction. In general, the law hinders rather than helps the spread of gas-heating in industry, and politicians obsessed with the organisation of electrical supply have done little to assist. In this direction smoke abatement organisations might use their influence.

The report records a study of the proportions of sulphur acids in the London atmosphere, where in foggy weather the quantity of sulphur dioxide may reach one volume per million, although normally it is much less. The work indicates the growing interest in sulphur impurities, the importance of which was emphasised by the tragedy of Liège last winter. It is unlikely that the

* Department of Scientific and Industrial Research. The Investigation of Atmospheric Pollution: Report on Observations in the Year ended 31st March 1931. Seventeenth Report. Pp. vii+110. (London: H.M. Stationery Office, 1931.) 5*s*. 6*d*. net.

absolute quantity of sulphurous impurities is increased by the concentration of power generation in central stations, but the consequences may become more serious for people and property in the immediate neighbourhood. On the other hand, this concentration of power production facilitates the application of processes for the desulphurisation of flue gases. The London Power Company claims to have worked out a practicable process by the use of lime water. Recent patent literature describes a process based on the use of ammonia, which has the merit of producing no intractable liquid effluent. Moreover, ammonia to-day, in the form of gas liquor, is cheap and freely available. It seems fitting that the alkali from coal should be used to neutralise its sulphurous products. However, it can scarcely be doubted that the atmospheric pollution by sulphur due to boiler furnaces can be largely removed when necessary steps are taken.

The report is a voluminous document, containing much interesting matter, both descriptive and tabular. One puts it down with regret that, together with so much knowledge of the problem and its remedy, there should be so little progress towards amelioration. H. J. HODSMAN.

Obituary

DR. E. H. GRIFFITHS, F.R.S.

DR. E. H. GRIFFITHS, formerly principal and professor of physics in the University College of South Wales and Monmouthshire, died, after a long and painful illness, on March 3, at his residence in Cambridge, in his eighty-first year.

Dr. Griffiths went to Cambridge from Owens College, Manchester, and entered at Sidney Sussex College. He took an ordinary degree in the Applied Science Special in 1873, and shortly afterwards started work as a private tutor, becoming associated with Dr. Campbell, a well-known coach for the examinations in law, and at a later date with the late Mr. C. T. Heycock. In this work he was very successful; pupils of Griffiths and Campbell usually did well in their examinations, and he was soon recognised as one who could be trusted to do his best for a lame dog.

It was not until much later (1889 or 1890) that it was realised that there was a physicist of very marked ability working almost in solitude at the Sidney Laboratory, where Neville and Heycock had been engaged on their well-known metallurgical researches. It was about this time that I first met him, when he came to the Cavendish Laboratory to ask me to standardise a resistance box he was then using—I was in charge of the British Association standards of resistance—and I then learned that he proposed to make what appeared to be a very ambitious attack on the determination of Joule's equivalent, employing the electrical method. To quote his own words from a later paper: "I commenced this work in 1887, and the general principle on which I proposed to proceed was that of eliminating the effects of conduction, radiation, etc., rather than of ascertaining the actual loss or gain due to these causes".

Griffiths' time during the next two years was devoted to preliminary work; difficulties inherent in the mercury thermometer led him to investigate platinum thermometers and the measurement of platinum temperature as introduced by Callendar in 1886.

The platinum temperature pt at any temperature t is obtained by measuring the resistance of a wire of platinum. Callendar showed (*Phil. Trans. Roy. Soc.*, A, 161; 1887) that the difference, $t - pt$, could be expressed in terms of pt by a formula involving a single coefficient, and at first supposed that this coefficient was the same for all wires of reasonably pure platinum. Griffiths in his paper (*Phil. Trans. Roy. Soc.*, A, 43; 1891) proved that while the formula held with great accuracy, the coefficient varied appreciably from wire to wire—no wire was absolutely pure—so that to standardise a platinum thermometer, a third temperature in addition to the freezing and boiling points of water was required, and in a further paper (*Phil. Trans. Roy. Soc.*, A, 119; 1891) Callendar and he communicated an accurate determination of the boiling point of sulphur, and described apparatus for making use of that temperature as a third standardisation point. The platinum thermometer thus became a reliable instrument. In this way means for the accurate measurement of the temperature of the calorimeter were provided, and his real work—the determination of the mechanical equivalent of heat, J—could begin, at first in the Sidney Laboratory. Cambridge trams soon made that impossible, and a special building was erected in his own garden.

The investigation described in his paper, "On the Value of the Mechanical Equivalent of Heat" (*Phil. Trans. Roy. Soc.*, A, 361; 1893), still constitutes the standard determination by the electrical method. It may be useful to quote the values of J deduced from the results of various experimenters by Griffiths himself in the "Dictionary of Applied Physics", vol. 1, 493; 1922, when reduced to the same units and on the assumption that the e.m.f. of a Clark's cell is 1·432 volts:

CAPACITY FOR HEAT OF WATER AT 20° (OF THE HYDROGEN SCALE)

Rowland, 1878	$4{\cdot}182 \times 10^7$
Griffiths, 1893	$4{\cdot}184 \times 10^7$
Schuster and Cannon, 1894	$4{\cdot}182 \times 10^7$
Callendar and Barnes, 1899	$4{\cdot}181 \times 10^7$
Mean	$4{\cdot}182 \times 10^7$

Any uncertainty in his result depends mainly on the uncertainty attaching to the electrical units of his day, and for the values of these he was dependent on the work in progress at the time at the Cavendish Laboratory.

For some years after this, Griffiths took an active part in discussions at the British Association and

elsewhere relating to electrical and thermal units. He became a fellow of the Royal Society in 1895, and in the same year joined the Electrical Standards Committee of the British Association. A provisional definition of the calorie as the heat required to raise a gram of water from 9·5° to 10·5° on the scale of the hydrogen thermometer, adopted at the Liverpool meeting in 1896, was the outcome of the replies sent by some twenty prominent physicists to a letter in which he urged the importance of international agreement as to thermal units.

On Griffiths' acceptance, however, in 1901 of the post of principal of the University College of South Wales and Monmouthshire, active experimental work ceased, pending the erection and equipment of a research laboratory. Administrative and educational duties absorbed his time for a number of years. At a later date the laboratory was erected, and along with Dr. Ezer Griffiths he published (*Phil. Trans. Roy. Soc.*, A, **213**, 119, and **214**, 319; 1914) two papers dealing with the capacity for heat of metals over the range from 120° abs. to 400° abs. Included in the latter paper is a comparison of their results with those given by various formulæ designed to represent consequences deduced from the quantum theory. The method employed was in every case electrical, utilising very effectively the experience gained in Griffiths' original work on *J*.

During the tenure of his principalship, Griffiths held many important positions; he was vice-chancellor of the University of Wales on three occasions, and served as president of two sections of the British Association. On his retirement in 1918 from his university offices he returned to Cambridge, and shortly afterwards became treasurer of the British Association. The death of Mrs. Griffiths the same year left him a changed man; she had been an invalid for some time, but much was hoped from a quiet life at Cambridge. However, this was not to be, and in the course of a few years Griffiths became a complete cripple, maintained alive, and to visitors happy and contented, by the care and attention of his nurse. His work was recognised by his College by his election as a fellow in 1897, and at a later date as an honorary fellow.

R. T. GLAZEBROOK.

News and Views

Award of Duddell Medal

THE Duddell Medal of the Physical Society was presented to Prof. C. T. R. Wilson, Jacksonian professor of natural philosophy in the University of Cambridge, at the annual general meeting of the Society, held on March 18. Prof. Wilson's contributions to physical science fall mainly into two groups: those associated with the investigation of the tracks of ionising particles on one hand and the investigation of atmospheric electricity on the other. The word 'cloud' is the appropriate symbol of both groups. In 1895, Prof. Wilson discovered that clouds could be produced in a super-saturated atmosphere freed from the dust particles, which the earlier experiments of Aitken indicated as an indispensable condition for initiating condensation. Two definite critical expansions corresponding to fourfold and eightfold super-saturation were found. Using an X-ray tube which had been made by Mr. Everett in the Cavendish Laboratory in 1895, Prof. Wilson observed again the formation of fog when the expansion was between the critical values. Further experiments revealed that purely ionising agents all produced nuclei on which water condensed when, and only when, the super-saturation exceeded the lower critical limit. The condensation nuclei were shown to be ions by their behaviour in an electric field. These investigations were applied by J. J. Thomson, H. A. Wilson, and R. A. Millikan to the measurement of the ionic charge; it was also shown that the degree of super-saturation required to cause negative ions to grow into visible drops leads to the value $4{\cdot}9 \times 10^{-10}$ e.s.u. for the elementary charge.

So long ago as 1911 Prof. Wilson devised an expansion apparatus with means of instantaneous illumination of the cloud particles for the purpose of photographing them. On the path of a primary X-ray beam he observed a large number of little patches of cloud representing the paths of very short cathode rays; these are now known to be the tracks of the recoiling electrons in the Compton effect. The final improvement of the expansion method consisted in taking stereoscopic pictures of clouds, and Blackett in particular has obtained photographs of the tracks from collisions of particles with atomic nuclei, indicating the atomic disintegration thereby produced. The work of Prof. Wilson in atmospheric electricity has opened up new and profitable fields of inquiry. His method of studying rapid changes of the earth's electric field, which is characterised by the experimental elegance evident in all his work, has led to a great increase in our knowledge of the electric fields associated with thunderstorms. His view that the earth's electric charge can be attributed to the action of thunder and shower clouds, the charges of which send negative electricity into the ground in sufficient quantity to balance the dissipation caused by the positive ion current constantly flowing to the ground, is generally accepted.

Protection of Beneficial Insects

WHILE special laws for the protection from wanton destruction of birds useful in agriculture exist in most countries of the world, parasitic and predaceous insects which are equally, and often much more, beneficial than birds remain unprotected. The main reason, of course, was that there was no need of such protection, but recently an interesting situation arose in Mauritius. A scoliid wasp, *Tiphia*, was introduced into that island from Barbados as a means of checking the beetle *Phytalus smithi*, one of the worst

pests of sugar-cane. Colonies of *Tiphia* were successfully established in several places, and the wasps began to spread, doing very useful work in the control of *Phytalus*. The beneficial effect of wasps was soon appreciated by sugar planters, who became very eager to secure the parasites for their own plantations. As a result, mass capture of the wasp and even a regular trade in them developed to such an extent that the carefully elaborated plans for a gradual establishment and spread of the parasite were in danger of being overthrown. In order to prevent this an ordinance has just been issued by the Government of Mauritius providing for the protection of any insect declared to be beneficial, and forbidding anyone to kill, injure, or molest any such insect. The declaration of an insect as beneficial rests with the Director of Agriculture, who is empowered to make surveys of private lands in order to ascertain the presence and the quantity of beneficial insects available for capture and distribution. The ordinance can be regarded as a *de jure* recognition of biological control of insect pests.

Federal Council for Chemistry

IN the report for 1931 of the Federal Council for Chemistry, the objects and constitution of the Council are defined with greater precision than heretofore. The objects are : to foster and advance the scientific interests of chemistry in all its branches, and to that end (1) to represent the views of British chemists both nationally and internationally, (2) to co-operate with those bodies in Great Britain and the British Empire representing the science of chemistry and to co-ordinate their scientific activity, (3) to enter into scientific relations and co-operate with similar bodies in other countries, and, in particular, to act as the representative of the British associations of chemistry in the International Union of Chemistry. The report states that a sum of £1642 was collected as the contribution of chemists and the chemical industries towards one-fifth of the estimated cost of the Faraday Exhibition in 1931. The committee appointed to consider the question of forming a British chemical standardising body having reported in favour of participation in the new British Standards Institution, unanimous approval of this course has been expressed by the Council. After consideration of the report of the Bureau of Chemical Abstracts on the memorandum submitted by Sir Frederic Nathan advocating the establishment of an international system for abstracting and indexing chemical literature, the Council has reaffirmed its previous decision that the system at present in use in England is satisfactory. Under the heading of international affairs it is announced that the ninth International Congress of Pure and Applied Chemistry and the eleventh Conference of the International Union of Chemistry, which were to have been held in Madrid in April 1932, have been postponed to a more favourable time. The report of the discussion on the chemistry of the carbohydrates held at Liège in 1930 has been issued in separate form, and can be obtained from the Société de Chimie Industrielle (50 fr.). During the year 1931 Russia was admitted an adherent organisation of the International Union of Chemistry.

Tropical Medicine and Hygiene

THE PRINCE OF WALES opened Manson House, the new headquarters in Portland Place, London, W., of the Royal Society of Tropical Medicine and Hygiene, on March 17. The premises will perpetuate the memory of Sir Patrick Manson, a pioneer in the science of tropical medicine. His Royal Highness pointed out that one of the great obstacles to the development of tropical countries is not so much the climatic conditions but the diseases which are prevalent in them. In spite of this, however, great progress has been made in the study of tropical diseases during the last thirty years. This progress has been due chiefly to the pioneer investigators who devoted their lives to the study of tropical diseases and medicine on the spot, thus saving the lives of hundreds of thousands of the inhabitants of the tropics, not only European but also the native population. One serious consideration at present is the increase in facilities for the spread of disease brought about by the improvement in communications. This problem must be attacked by the investigation of collected pathological material and the establishment of centralised research to help other centres in the investigation and control of disease. In Manson House, discoveries, experiences, and opinions of workers in tropical lands can be pooled for the help of those who will have to face similar problems in the future.

Climate and Soil Physics

DR. B. A. KEEN, assistant director of the Rothamsted Experimental Station, delivered the G. J. Symons memorial lecture before the Royal Meteorological Society on March 16, his subject being " Soil Physics in Relation to Meteorology ". Dr. Keen introduced his subject with a description of the different soil types found in different climatic zones. In soil temperatures, the porous and moist nature of soil produces special effects. In particular, the downward percolation of water appreciably reduces the loss of heat from the soil. A full account was given of recent investigations at Rothamsted on the movement and distribution of water in the soil. It was shown that such movements are much less, both in amount and extent, than previously supposed. Water which has reached a depth of about six feet in the average soil is not drawn back to the surface again by evaporation. Many of the farmers' and gardeners' cultivation operations were at one time supposed to conserve this subsoil water for use by plants, but the explanation has now to be sought for in other directions. The lecture concluded with a review of the development of cultivation implements, from the rudimentary form of a pointed stick, which merely stirred the ground, to the wide range of different types now in use.

The Talkatome Home 'Talkie' Equipment

HOME film projectors were popular a few years ago; but apparently silent films are becoming out of date. A demonstration was given by the British Talkatome, Ltd., at their offices at Wells Street, Jermyn

Street, London, S.W.1, on March 16, of a sound apparatus for home use. The device consists of a synchronised turntable attached to the projector by a flexible drive. A special sound disc is used in conjunction with the film, and this is placed on the turntable. An electrical pick-up carries the gramophone needle, which is connected to a loud speaker either by the user's radio set or alternatively by a special amplifier. The makers have prepared a library of films, including comedies and travel and educational films. The device shown worked quite satisfactorily, and the operation of the equipment is simple. In some cases it might be useful in colleges and schools. The turntable is listed at twenty-five guineas, and the hire of a film from the library is 10*s*.

Witchcraft on the Gold Coast

THE Christian Council of the Gold Coast, a body consisting of representatives of all denominations, of which the Anglican Bishop of Accra is chairman, has taken the unusual course—not, however, without precedent in spiritistic circles—of issuing a challenge to witchcraft. The Council has published a notice in the local press that it is prepared to pay the sum of £10 to any person who, within the term of six months from date, will either 'eat' a papaw, or some other fruit selected by the Committee, at a distance of five yards, without coming into physical contact with it; or extract from a sealed box, without breaking the seal, an article deposited in it by the Committee; or transform himself into any beast, bird, or creeping thing. All these operations are among the powers attributed to the local witches. The Council, in making this challenge, is careful to point out that while many innocent persons are put in great terror by their fear of witchcraft, the harm from it is due not to the powers of witchcraft, but to their fear. Even with this proviso, however, the Council would appear to have been unsuccessful in its attempt to avoid criticism. Objection has been taken to its action on the ground that it constitutes 'witch-finding', and as such is contrary to a local ordinance.

EXTRACTS from the local press criticising the Council are quoted in an article describing the situation at Accra, which appeared in the *Manchester Guardian* of March 15. The Council is recommended to abstain from meddling with witchcraft; and as it does not affirm or deny the belief, it is advised "to leave the Devil alone". Apparently the Council takes its stand on precedent; for it recalls that in the last hundred years the power of 'fetish priests' has been broken in this manner on many occasions. The action of the Council is directed against 'witch-finders' as well as the witch. Some idea of the conditions with which the churches have to deal may be gained from a case quoted from the *Vox Populi*, a local journal, of Feb. 20, which reports the 'finding' of a witch, who was charged with killing the child of a sister. When the dead child was placed on her lap, a snake fell from her body. This was taken as proof positive of her guilt, and the woman had to be conveyed away secretly to save her from popular vengeance.

Prehistoric Society of East Anglia

AT the annual meeting of the Prehistoric Society of East Anglia, held at Norwich on Feb. 29, Mr. J. Reid Moir was elected president. In a paper on the evolution of the rostrocarinate and hand-axe in north-east Ireland, Mr. J. P. T. Burchell described the geological conditions under which specimens he exhibited were collected. Mr. J. Reid Moir reviewed the typological evidence of the exhibits, showing that the line of evolution from ancestral eolithic forms and the technical methods of flaking used were identical with those in the lower palæolithic industries of widely separated regions. Dr. Muir Evans exhibited a fine bone harpoon from the North Sea bed, deeply peat-stained and similar to the two examples from Holderness now in the British Museum. The specimen came from a large mass of 'moorlog' dredged up between the Leman and Ower sandbanks, about thirty-five miles east of Happisburgh lightship, by the trawler *Colinda*. Mr. M. C. Burkitt accepted the harpoon as clearly of Maglemose type. The specimen has been presented to the Norwich Museum.

Fungicide for Oat Seed

EXPERIMENTS carried out at the North of Scotland College of Agriculture, at Craibstone, in 1931, clearly demonstrate the value of dressing oat seed with 'Ceresan', for on an average the yield of grain was 6 cwt. and the yield of straw 8 cwt. per acre higher on the treated than on the untreated plots. Ceresan is a mercuric compound in the form of a dry powder, which, when mixed with the seed, kills any fungi that may be adhering to the grain. Thorough mixing is essential if the treatment is to be successful, and special machines are now on the market for the purpose. An old churn, however, has been used at Craibstone with very satisfactory results. Mixing on the floor with a shovel is not recommended, partly on account of the difficulty of obtaining a sufficiently thorough mixing by this means, and partly because of the poisonous nature of the compound and the consequent risk of danger to live stock. Care is therefore needed in handling the powder, and if large quantities are being used, it is advisable for workmen to cover their noses and mouths as a precautionary measure. Five ounces are required for every hundredweight of seed, the cost, exclusive of labour, working out at less than one shilling per acre. Although a good stand of oats, such as was obtained on the plots where the seed had been treated, is eminently desirable, too thick a crop is liable to suffer from lodging, and it seems possible that a saving of seed could be effected if Ceresan treatment were carried out. This and other points of importance, such as the influence of weather conditions at harvest on the effectiveness of the treatment, etc., will be investigated in the experiments which are being continued at Craibstone in the present season.

Submerged Canyon of the Hudson River

SCIENCE Service has issued a summary of a recent United States broadcast talk on hydrographic matters, by Lieut.-Comm. R. R. Lukens, of the United States

Coast and Geodetic Survey. Among the various interesting topics dealt with, is the remarkable submerged canyon of the Hudson River, about fifty miles at sea off the entrance to New York Harbour. This great gorge, approaching in magnitude the Grand Canyon of the Colorado, is at one place more than 2400 ft. deep, and three miles wide from rim to rim; it is about twenty miles long, and at its opening spreads out fan-like. It is of use during fog, as a 'seamark' for vessels equipped with sound-echo apparatus. Springs welling up in the sea are also described, both water springs and oil springs. One of the former, off the Florida coast, sends up millions of gallons of fresh mineral water from a hole about 25 ft. in diameter and 70 ft. deep in the ocean bed, itself 50 ft. deep; the water springs up with considerable force, so that it is difficult to hold a boat over it, and it has a sulphurous smell. Elsewhere, off Alaska, the sea-bottom sounding lead, 'armed' with tallow, shows gold dust as a bottom characteristic; but the depth is too great to permit of dredging. Other remarkable ocean features off Alaska are pinnacle rocks, often extending to within a few feet of the surface, which are the cause of many shipwrecks: and a submarine volcano, rising from a depth of nearly 6000 ft., which throws up islands and blasts them again with violent explosions, nearly every year witnessing some change in the appearance of the island.

Preservation of Chillingham Cattle

THE appeal, to which reference has been made (NATURE, Feb. 13, p. 241), has now been issued by the Zoological Society of London. Recognising the particular interest of the famous herd of white park cattle at Chillingham Castle, and the impossibility of its maintenance, under present financial conditions, by the owner, the Earl of Tankerville, the Council has taken a lease of the Park for seven years at a rental of £500 annually. Of this sum the Council has promised to contribute £100 annually for the seven years, and it appeals, through the three Trustees appointed for the purpose, for assistance in raising the balance required. The cattle herd, which has been enclosed for many centuries, now consists of forty-four animals. It has always been left to follow its own devices, so that annually a master bull fights his way to supremacy, and the retiral of the cows to calve in the woods, where they conceal their young for nearly a fortnight, recalls the habits of the wild extinct ox, or urus, which inhabited prehistoric Britain. The cattle are so wild as to be unapproachable, but arrangements have been made whereby subscribers to the fund may have entry to the Castle grounds and access to a safe place from which the herd may be viewed. Donations or annual subscriptions should be sent to the Secretary, Zoological Society, Regent's Park, London, N.W.8, marked "Chillingham Cattle Fund".

Future Methods of Charging for Electric Supply

SIR JOHN BROOKE, vice-chairman of the Electricity Commissioners, at a conference on electric light in architecture, organised for architects by the Lighting Service Bureau, gave an interesting address on the future charges for electricity in London. He pointed out that the aim of the Commissioners is to secure a reasonable uniformity of charge. They have chosen as a basis the two-part tariff—frequently known as the telephone system. The fixed charge is based on the floor area that has to be lighted, and they have devised a scheme for calculating this area. They suggest alternative schemes based either on the number of rooms or the rateable value of the house. In addition to the fixed charge, there is a low running charge made for the energy consumed, which is registered by the meter. He said that the tariff was not popular at first and was not generally accepted. Business men accustomed to dealing with problems of overhead charges and running costs considered it perfectly equitable that everyone who has electricity on tap should pay, in the first place, his share of the capital charges. In five years' time there will be everywhere available—if not compulsory—a two-part tariff. This is of great importance, because in considering the relative costs between minimum lighting, adequate lighting, and that generous scale we should call proper lighting, we have only to reckon on the additional running cost per unit. In the future these additional units will not cost 4*d*., 6*d*., or 8*d*., but will cost ½*d*., 1*d*., or 1½*d*. The reasonable anticipation that tariffs of this nature will be available in a few years' time, with a steady tendency to reduce the running charge to ½*d*. a unit, as it is in several districts in the neighbourhood of London, will obviously popularise the use of electricity for many purposes from the radio receiver to the vacuum cleaner, and make necessary the introduction of many outlet points when designing the electric wiring of a house.

Institution of Mechanical Engineers

THE Report of the Council of the Institution of Mechanical Engineers for 1931 states that the total membership of the Institution now stands at 11,161, an increase of 155 on that of 1930. The losses by death numbered 103, among the deceased members being Prof. Archibald Barr, Sir Trevor Dawson, Sir Charles Parsons, Sir A. J. C. Ross, and Sir Thomas Stanton. There are now eight branches of the Institution in the provinces and one in South America, and four graduates' sections, all of which have their own programmes of papers. Research work is being continued on alloys, cutting tools, marine engine trials, welding, wire ropes, and other subjects. The Institution has representatives on many boards and committees, including the Royal Society's committee for founding a memorial to the late Sir Charles Parsons. A large number of candidates were examined in England, Scotland, and Ireland for the national certificates and diplomas in mechanical engineering, and the first diplomas were issued for officers of the Royal Air Force, the examination being held in conjunction with the Board of Education and Air Ministry. The Report contains particulars of the awards made for papers read, full details of the finances of the Institution, and records the receipt of gifts, which include a replica of the memorial tablet to George Stephenson at Wylam,

a portrait of the late Sir John Thornycroft, and a commemoration medal of the late Prof. Auguste Rateau.

Standardisation of Electric Frequency in Paris

ONE of the difficulties in connexion with the nationalisation of the British system of electric supply is the fact that many large systems are using a different frequency of supply from the chosen standard of 50. The discussion, therefore, on the standardisation of the frequency of electricity supply in Paris, held at the Institution of Electrical Engineers on Feb. 29, was a timely one. P. Rieunier exhibited a film which showed clearly how rapid the conversion had been. The Paris area extends in a circle of about thirty miles in radius around Paris. Before the War it was supplied at four different frequencies by various undertakings. In 1919 it was decided to build large modern steam-generating stations in Paris and connect them with a 60 kilovolt ring main around the city, which was also connected by transformers to the hydro-electric stations of the Central Plateau through the 120 kv. and 220 kv. mains. In addition, it was decided to create a national network at a frequency of 50 which could be converted into direct current at the highest possible voltage for the electrification of the railways. Instead of having a grid round the country as in England, connected with large and efficient generating stations, France has a series of lines radiating from the principal centres of consumption. In Paris the conversion of the two-phase to direct current is carried out by rotary converters and mercury arc rectifiers. On the 25 frequency network all motors are replaced either by new or second-hand motors having twice as many poles. On the $41\frac{2}{3}$ frequency network the motors have been unchanged, but the mechanical units to which they are coupled have been adapted to work at a 20 per cent increase of frequency. Luckily the motors were originally manufactured in 50 frequency frames, so it was only necessary to speed them up to the figure for which they were originally designed. Difficulty was experienced in converting small motors such as those used for calculating machines and similar apparatus.

Books for the Blind in the United States

THE Report of the Library of Congress, Washington, D.C., for the year ending June 30, 1931, is a volume of 463 pages, which includes a review of the activities of its various divisions and gives much interesting information regarding the books and manuscripts acquired during the previous twelve months. The total number of books and pamphlets is now 4,292,288, as against 4,103,936 in June 1930. "A new responsibility imposed upon us by legislation at the last session", says the report, "concerns the supply of books (in embossed type) for the blind." It is embodied in an Act approved on March 3, 1930, which makes an appropriation of 100,000 dollars to provide books for the use of adult blind residents of the United States. For some time past the Library has done notable work for the blind, and now has a collection of 22,655 books, periodicals, music, etc., mainly in Braille. During the year 1930–31 there were 3359 registered borrowers and 52,222 issues of books, etc. Of this number, 39,330 were works of fiction, 2758 histories, 2444 biographies, and 739 scientific works. With the American National Red Cross, the Library of Congress maintains a Braille transcribing service for the production of Braille manuscript. Lessons are arranged for, certificates of competency are granted, and manuscripts are prepared, bound, and distributed. During 1930–31, 247,708 pages of Braille were completed and, in book form, distributed among 53 institutions, libraries, and individuals. The students helped represented 34 colleges, high schools, and universities, and assistance was given to persons engaged in many callings. But great as is the service rendered, still more is required, and "no private gifts or public funds yet in sight can meet all the growing needs of touch readers".

Biochemical Research in India

THE Society of Biological Chemists in India, recently founded by the enterprise of certain members of the Department of Biochemistry of the Indian Institute of Science, Bangalore, has published a review of work carried out in India during 1930 ("Biochemical and Allied Research in India in 1930": Society of Biological Chemists, India). The Society was founded to co-ordinate the work carried out in various parts of the country, and to arrange for the holding of meetings either of members of the Society alone or in association with other societies, for the exchange of ideas and the reading of papers. At present it is not proposed to issue a journal, although this may be practicable in the future as the volume of biochemical research increases. The present review, a pamphlet of twenty pages, deals with work on enzymes and fermentation, agricultural, dairy, plant, animal, and pharmaceutical and medicinal chemistry, nutrition and bacteriology. Reference is made to nearly a hundred original papers published during the year, which incidentally was the first working year of the new Imperial Council of Agricultural Research. The important work carried out by Chopra and his collaborators at the School of Tropical Medicine and Hygiene in Calcutta on the chemistry of Indian drugs, and by McCarrison at the Pasteur Institute, Coonoor, on nutritional problems is referred to, and the hope is expressed that workers will soon be attracted to the field of chemical and biological assay of drugs. The review indicates the rich field for research awaiting the attention of biochemists and pharmacologists in India.

The Epithalassa of the Strait of Georgia

THESE conditions have been described by A. Hutchinson and C. C. Lucas (*Can. J. Research*, vol. 5, 1931, 231–284). The Strait of Georgia is a great basin connected with the sea by narrow passages which receive water from a number of large rivers, notably the Fraser River. The water from the latter is conserved during the summer and forms a marked upper layer, the epithalassa, which is characterised by low salinity and high temperature. The temperature may be as much as 10° C. above the water of the sea. Throughout the greater part of the region this epithalassa has a stability which is sufficient to

resist tidal and wave movement. Abundance of fish food in the form of plankton is present, and the amount is greatest in the region where the most complete mixing of the river and the sea water takes place. The data presented are thought to have an economic bearing upon the fisheries, the establishment of oyster beds, the development of clam beaches, of crab and shrimp industries, and in the location of summer resorts.

Seismological Society of America

THE last two numbers of *Earthquake Notes* report the proceedings of the Eastern Section of the Seismological Society of America. Arrangements have been made with the directors of the Society by which it is provided that longer articles read before the Eastern Section shall be published in the Society's *Bulletin*, the *Notes* being reserved primarily for notes and news. The recent numbers contain a summary of the papers that were read at the annual meeting of the Section held at Columbia, S.C., on June 11–12, 1931. Most of the papers are devoted to instruments and their records, with one recalling the Charleston earthquake of 1886, some of the effects of which were seen during an excursion to that city. We have also received the last four quarterly numbers (for July 1930–June 1931) of the valuable *Bibliography of Seismology* issued by the Eastern Section, in which the titles, with occasional brief abstracts, are given of four hundred memoirs dealing with earthquakes.

Library of the Royal College of Surgeons

A LIST has been published of the volumes in the library of the Royal College of Surgeons ("List of the Transactions, Periodicals, and Memoirs in the Library of the Royal College of Surgeons of England." London: Taylor and Francis, 1931. 2*s*. 6*d*.). This is the second edition, the first having been published in 1890: it contains about twice as many entries as the latter. Perusal of the list shows that the library contains, in addition to the commoner periodicals devoted to medical and allied sciences, a great variety of pamphlets and journals of considerable historical interest, to which access is generally difficult. The list should be of value to librarians and research workers who may desire to refer to papers published in the lesser known or ephemeral journals, as well as to those interested in the history of medicine.

Microlepidoptera of Eastbourne

IN vol. 10 (second supplement) of the *Transactions of the Eastbourne Natural History, Photographic and Literary Society* for 1931, Mr. Robert Adkin contributes a carefully prepared list of the 'Microlepidoptera' and the more primitive of the larger moths of the Eastbourne district. The list is annotated with many natural history details of considerable interest, and is illustrated by twenty-five excellent photographic plates giving natural-size reproductions of many of the species enumerated. The list is one which will commend itself to anyone interested in the groups of insects dealt with, and is obtainable at the Society's rooms at the Technical Institute, Eastbourne, price 3*s*. 6*d*. net.

Retting of Wool

WRITING from the Wool Research Department, Massey Agricultural College, Palmerston North, New Zealand, Mr. R. Waters says: "It may be of interest to those engaged in wool research to know that the fibre may be broken down into its constituent cells by retting it in a culture of what appears to be a variety of *Bacillus vulgatus*, and that this process may conveniently be used to provide cell material for study. The organism apparently does not attack the cells, the material obtained appearing quite normal." Details of the technique employed may be obtained from Mr. Waters.

Announcements

PROF. E. S. GOODRICH, Linacre professor of zoology and comparative anatomy in the University of Oxford, has been selected by the Council of the Linnean Society of London as the recipient of the Linnean Medal, which will be presented to him at the anniversary meeting on May 24.

IT is announced in the *Fight against Disease*, the quarterly journal of the Research Defence Society, that the Hon. Sir Arthur Stanley has accepted the chairmanship of the Society in succession to the late Lord Knutsford.

IT is announced in *Science* that Dr. T. W. Stanton, geologist in charge of palæontology and stratigraphy in the United States Geological Survey, has been appointed chief geologist, succeeding Dr. W. C. Mendenhall, who has become director of the Survey.

MESSRS. W. and G. Foyle, Ltd., 119 Charing Cross Road, W.C.2, have just circulated a catalogue of medical books offered for sale by them, which many readers should find useful.

A COPY of catalogue No. 3, 1932, of Messrs. Oppenheim and Co. (Rare Books), Ltd., 317A Fulham Road, S.W.10, has reached us. It gives the titles of about 900 works dealing with science, and is particularly strong in sets and long runs of publications of the learned societies.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in education in the University of Manchester—The Registrar, The University, Manchester (April 2). A full-time engineering workshop instructor at the L.C.C. Paddington Technical Institute—The Education Officer (T.1), County Hall, S.E.1 (April 2). An assistant lecturer in pharmacy at the Bradford Technical College—The Principal, Technical College, Bradford (April 6). A professor of physics at University College, Southampton—The Registrar, University College, Southampton (April 16). A chief metallurgist for the Tata Iron and Steel Company, Jamshedpur, India—Tata, Ltd., Capel House, New Broad Street, E.C.2. A head of the department of mechanical and structural engineering and building of the Borough Polytechnic, Borough Road—The Principal, Borough Polytechnic, Borough Road, S.E.1.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Spectrographic Observations of Infra-Red Lines in the Auroral Spectrum

THE importance of obtaining auroral spectra in the infra-red has long been recognised, and such investigations have formed part of my spectroscopic programme for the new auroral observatory at Tromsø. Preparations were made last summer and through Dr. Brücke and Dr. Lacmann, of Berlin, I was recommended to use Agfa Infra-Red Plate 810 with a suitable

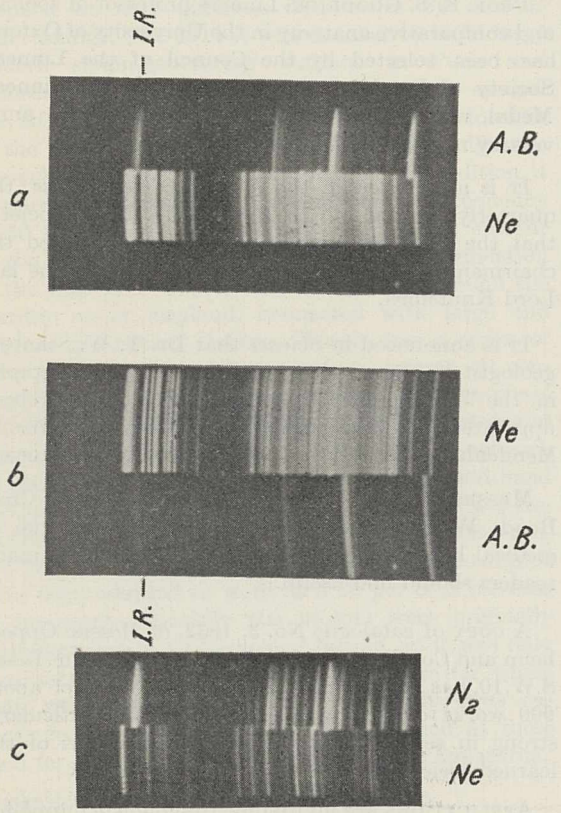

FIG. 1.

sensitiser. These plates were tested last autumn and found suitable. After having carried out some precision interferometer measurements of the wave-length of the auroral line 5577·35[1], spectrographic exposures of the aurora with infra-red plates of the kind mentioned were begun under the guidance of Mr. L. Harang.

During an auroral display on Feb. 4, two small glass spectrographs were in operation; each of them gave good spectrograms showing strong lines in the infra-red, and the well-known spectrum in the blue part. The strong green line is absent because the plate is very insensitive in that region.

The spectrogram (*a*) of Fig. 1 gives the strongest lines, and was taken with a broad slit. As the neon comparison spectrum is somewhat overexposed, it is to be expected that this plate will give a less accurate wave-length determination than the spectrogram (*b*) taken with a narrow slit. Our wave-length determinations will therefore be based on the latter spectrogram.

The spectrum in the infra-red has the appearance of one strong and one weak narrow band with sharp edges towards long wave-lengths. They have very much the appearance of band sequences belonging to the first positive group of nitrogen.

On account of the small dispersion in this region (1400 A./mm. on the original plate), wave-length determinations cannot claim any great accuracy. In order to estimate the possible error, we measured the strong lines 4208 and 3913, and we obtained the values 4207 and 3912 respectively. The average dispersion in this region is 122 A./mm. and the error of A. should correspond to 12 A. in the region of the infra-red auroral lines.

The wave-lengths found for these two infra-red auroral lines are: $\lambda = 7883$ strong; $\lambda = 8095$ weak.

If the auroral line 5577 is to be identified with the oxygen line observed by McLennan, we should expect a number of oxygen lines to appear in the infra-red. The most prominent oxygen lines are the first principal triplet of the Runge-Paschen series (7772, 7774, 7775), the three triplets of the series of Kiess, one between 8233 and 8221, the second between 7952 and 7948, and the third between 7481 and 7476.

None of these oxygen lines can be identified with the two infra-red auroral lines.

Nitrogen shows a spectrum in the infra-red very similar to that of the auroral spectrum (Fig. 1 *c*), which belongs to the first positive group. For the wave-length of the strongest heads we find $\lambda = 7722$, and this cannot be identified with the strongest head of the auroral infra-red spectrum.

On account of the large intensity of the infra-red auroral lines, only oxygen and nitrogen can come into consideration. As they are not (O I) lines, they most likely must be referred to nitrogen. As the positive group appears fairly strongly in the auroral spectrum, it is to be expected on account of the mutual relation between the first and second positive group that the first positive group should also appear fairly strongly in the infra-red.

If we write the formula for the first positive group:

$$\nu = 10979 + 1718{\cdot}4n_1 - 14{\cdot}44n_1^2 - 1474{\cdot}4n_2 + 13{\cdot}98n_2^2,$$

then the strongest head in the infra-red auroral spectrum nearly coincides with lines of the first positive group corresponding to the following transitions:

n_1.	n_2.	λ.
1	0	7885
7	7	7896
12	13	7863

The last transition can scarcely come into consideration.

In order to settle the question as to the exact interpretation of the infra-red auroral spectrum, we shall have to wait for more accurate determinations. Observations with a spectrograph of much larger dispersion are now in progress. L. VEGARD.

Physical Institute, Oslo,
Feb. 22.

[1] NATURE, 129, 23; 1932.

Origin of the Coronal Lines

THE spectrum of neutral oxygen has been analysed by Runge, Paschen, Hopfield, McLennan, and especially by Frerichs.[1] The deep terms $^3P_{210} = 109837{\cdot}3$; 109679·2; 109610·5; $^1D_2 = 93970{\cdot}3$; $^1S_0 = 76045{\cdot}6$ account for the green and red lines in aurora and nebulæ ($\lambda\lambda$5577; 6300; 6364). Still, there are a few

isolated lines of groups in the spectrum unclassified and not connected by known terms. These groups are:

I. (4)6654·121, (5)6374·292, (4)6366·282.

II. (1)6266·692, (2)6264·346, (5)6261·314, (1)6258·965, (3)6256·616.

III. (3)5995·198, (1)5993·102, (2)5991·852, (1)5991·255.

Now the last group has been found to be a combination between the known term $3p\ ^3P_{21}$ (− 3456·4; − 3459·8) and a new term $^3D_{321}$ (− 20135·2; − 20141·1; − 20142·8). This new term also combines with the ground triplet $2p\ ^3P_{210}$ and accounts for the unclassified lines, (0)770·70, (1)770·28, (2)679·39 in the far ultra-violet.

The groups II. and I. can be connected by the term difference $\Delta\nu = 19{\cdot}8$ and interpreted as combinations between a new set of deep levels: $P = 94925{\cdot}1$; $Q = 94905{\cdot}3$; $R = 94898{\cdot}7$; $X = 79221{\cdot}7$; $Y = 78946{\cdot}2$; $Z = 78932{\cdot}3$. The line 6654 ($Y\ ^1D_2$) forms the link with the $^1D_2$ metastable level that involves the green and red lines in aurora and nebulæ. The red coronal line 6374·29 is the XQ combination. Hopfield has already directed attention to the fact that this line may be interpreted as the unclassified oxygen line.[2] The newly detected red coronal lines, λ(2)6704 (Grotrian 1929) and λ(8)6776,[3] have the difference $\Delta\nu = 158$, that occurs in the $2p\ ^3P_{21}$ ground triplet of neutral oxygen, and form the combinations $2p\ ^3P_2 - 8P$ and $2p\ ^3P_1 - 8P$.

It is now also possible to calculate from laboratory data the green coronal line 5303, known since 1869, but never identified, notwithstanding numerous attempts. All the strongest coronal lines in the visible spectrum are now connected with terms of neutral oxygen. The Zeeman effect of the line 6374 will possibly give us the nature of the new terms. It may be that the configuration sp^4 plays a rôle.

CORONAL LINES

Int.	λ obs. (Corona.)	λ calc. (Laboratory.)	ν calc.	Combination.	Author.
8	6775·90	6775·90	14754·1	$2p\ ^3P_1 - P$	Mitchell, *Astr. J.*, **1**; 1932
2	6704	6704·07	14912·2	$2p\ ^3P_2 - P$	Grotrian, *Z. Astr.*, **2**, 106; 1929
12	6374·28	6374·29	15683·6	$Q - X$	Mitchell, 1932
20	5302·78	..	..	..	Campbell and Moore, *Lick. Obs. Bull.*, x, 318, p. 13; 1918
	5302·8±0·2	5302·70	18853·1	$R - 2p\ ^1S_0$	Davidson and Stratton, *Mem. R.A.S.*, **64**, 141; 1927
	5302·6—5303·4	..	..	..	Mitchell, 1932

It should be noticed that the green auroral line 5577 and the green coronal line 5303 both have their origin in the same metastable level of the neutral oxygen level, $^1S_0$. The mysterious 'coronium' turns out to be neutral oxygen.

In the near future we hope to publish a more extensive report on the spectrum of the solar corona.

T. L. DE BRUIN.

Laboratory "Physica" of the University of Amsterdam, March 11.

[1] *Phys. Rev.*, **34**, 1239; 1929; **36**, 398; 1930.
[2] *Phys. Rev.*, **37**, 160; 1931.
[3] Mitchell, *Astr. J.*, Jan. 1932.

Passage of Neutrons through Matter

THE discovery by Dr. J. Chadwick [1] of strong experimental evidence in favour of the existence of neutrons of mass approximately that of the proton makes it imperative that as many lines of attack as possible on the problem of determining the nature of this particle be developed. Thus, it is clearly very important to determine the nature of the field surrounding the particle. In order to investigate this, the simplest method is to examine the interaction of a neutron with other material particles such as atomic electrons. Thus, the measurement of the number of ions produced per centimetre by neutrons of different velocity should lead to a method of determining the field. It has therefore been thought of interest to give a preliminary account of the results of theoretical calculations of the behaviour of possible neutrons in this respect.

As the mass of the neutron is nearly that of a hydrogen atom, it cannot be the one suggested by

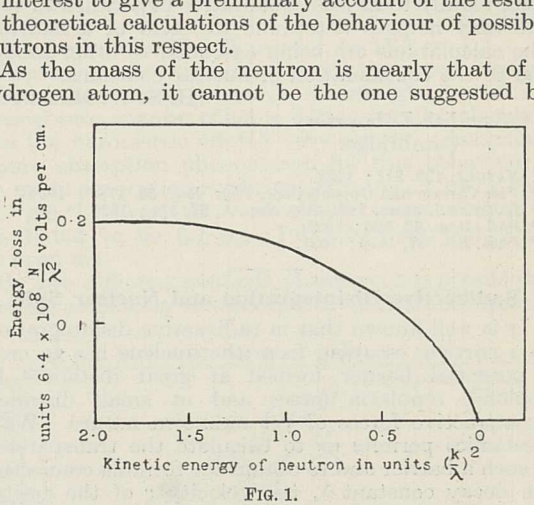

FIG. 1.

Pauli,[2] which has a smaller mass. The only models which seem at all likely for the particle are as below.

(*a*) A hydrogen atom in nearly zero quantum state. This possibility was discussed in 1920 by Lord Rutherford,[3] and experiments were actually carried out by Glasson [4] in the following year in order to ascertain if such particles occurred in discharge tubes. Recently, Langer and Rosen [5] have discussed this model from the point of view of quantum theory.

For such a system the interaction energy between an electron and a neutron would be of the form

$$e^2 e^{-\lambda r},$$

where the parameter λ would be connected with the energy of binding $-E$ ergs, by some formula of the type

$$\lambda^2 = \frac{8\pi^2 m^*}{h^2} E.$$

The mass m^* would probably be nearly that of an electron, but, as the binding energy is almost certainly greater than the rest mass of the electron, it is somewhat doubtful what mass one should take.

(*b*) A dipole of strength $a \sim 10^{-13}e$. This model would seem to be less likely than the first.

Using the first and more probable model, the rate of loss of energy in collisions with electrons per centimetre path of a neutron in passing through a gas containing N electrons per c.c. has been calculated. It is found that this loss of energy is given by

$$-\frac{dT}{dx} = \frac{2\pi e^4}{mv^2} N \left\{ \log \frac{\lambda^2 + 4k^2}{\lambda^2} - \frac{4k^2}{\lambda^2 + 4k^2} \right\},$$

where m is the mass of the electron, λ is the field parameter defined above, v is the velocity of the neutron, and $k = 2\pi Mv/h$, M being the mass of the neutron. This formula is valid provided the velocity of the neutron is greater than the orbital velocity of the atomic electrons.

The interest of the above result lies in its difference from the corresponding formula for charged particles. Thus, for $k < \frac{1}{2}\lambda$, the above expression shows that the loss of energy decreases with decrease of velocity, a result very different from the case of, say, α-particles. When $k \simeq \lambda$, the variation with velocity is very slow,

and for $k \gg \lambda$ the behaviour resembles that of a charge (this depends on the assumptions made regarding the internal field). This behaviour is illustrated in Fig. 1.

The peculiar form of the above expression lends itself readily to at least qualitative experimental test, and may help to determine the field of a neutron. The calculations are being extended to other models and to the consideration of nuclear collisions.

H. S. W. MASSEY.

Cavendish Laboratory,
Cambridge.

[1] NATURE, **129**, 312; 1932.
[2] *Vide* Carlson and Oppenheimer, *Phys. Rev.*, **38**, 1787; 1931.
[3] Bakerian Lecture, *Proc. Roy. Soc.*, A, **97**, 374; 1920.
[4] *Phil. Mag.*, **42**, 596; 1921.
[5] *Phys. Rev.*, **37**, 1579; 1931.

Radioactive Disintegration and Nuclear Spin

IT is well known that in radioactive disintegration, an α-particle escaping from the nucleus has to cross a potential barrier formed at great distances by Coulomb repulsion forces and at small distances by attractive forces of yet unknown nature. Wave mechanics permits us to calculate the transparency of such a barrier and to obtain the formula connecting the decay constant λ, the velocity v of the ejected α-particle, the charge number Z of the disintegrating element, and the radius r_0 of the internal nuclear region.[1]

Using the experimental values of Z, v and λ, it is possible to calculate the radii of different radioactive nuclei which are shown in Fig. 1. For the thorium

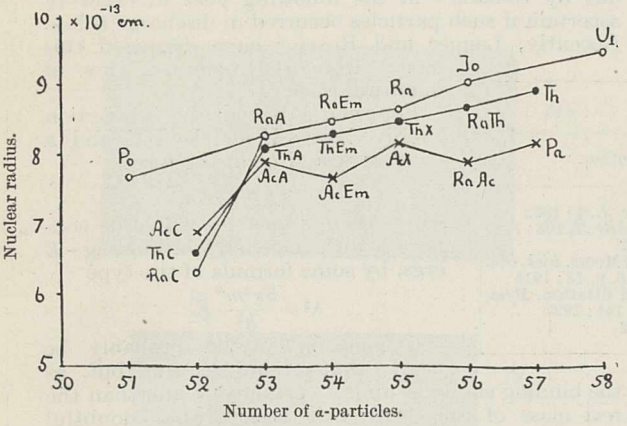

FIG. 1.

and uranium families the values of the nuclear radii vary rather regularly with increasing atomic weight, whereas for the actinium family a number of irregularities is present. This may be either because the radii of this family really do vary irregularly, or because all the factors are not taken in account by the calculations.

In the formula by means of which the values of radii shown in Fig. 1 have been calculated, the angular momentum i of an escaping α-particle was supposed to be zero. The presence of angular momentum increases the height of the potential barrier (the centrifugal force added to the Coulomb forces) and gives smaller values of the decay constant for the given r_0, or, the other way round, the neglect of this momentum leads to too small values of the radius, which is just the case for some members of actinium family. On the other hand, if nuclear spins of different elements which have been investigated are examined, it is seen that the nuclei with even atomic weights (to which the thorium and uranium families belong) usually have no spin at all, whereas for those with odd atomic weights (for example, the actinium family) the nuclear momenta can take rather different values (from $\frac{1}{2}$ up to $\frac{9}{2}$).

If the nuclei of the elements which are disintegrating and their products have different spins, the ejected α-particles must have angular momentum. The formula for the decay constant can be, in this case, written in the form:

$$\lambda_j = \frac{\pi h}{2mr_0^2} \cdot e^{-\frac{4\pi e^2}{h}\frac{(Z-2)}{v} + \frac{8e\sqrt{m}}{h}\sqrt{(Z-2)}\cdot\sqrt{r_0(1-\sigma)}} \qquad (1)$$

$$\sigma = \frac{h^2}{2m}\frac{j(j+1)}{r_0^2} : \frac{2(Z-2)e^2}{r_0} = 0{\cdot}002j(j+1),$$

where h denotes (Planck's constant)$/2\pi$.

Using this formula we can, for example, estimate the correct value of the atomic radius of actinium emanation by ascribing to the α-particle escaping from this nucleus an angular momentum of about three units, which means that the difference between the nuclear spins of actinium emanation and actinium-A is about $\frac{9}{2}$.

Such calculations, although uncertain, can give some idea of the spins of radioactive nuclei. Considerations of the same kind can also be applied to the decay processes when escaping α-particles leave the nucleus in an excited state,[2] although in these cases the estimations must be still more uncertain owing to the increase of the nuclear radius by excitation.

G. GAMOW.

Club of Scientists,
Leningrad, Feb. 8.

[1] G. Gamow, "Constitution of Atomic Nuclei and Radioactivity," Oxford. 1931.
[2] G. Gamow, NATURE, Sept. 13, 1930.

Molecular Structure of Polysaccharides

IN the issue of NATURE of March 5, Prof. W. N. Haworth announces that he has isolated tetramethyl glucose by hydrolysis of a fully methylated cellulose, and, on the basis of this result, he makes certain suggestions regarding the probable dimensions of the cellulose chain. In addition, he states that he is undertaking a similar research on other polysaccharides, and the letter closes with a claim for reservation.

It ought not to be necessary to point out that this laboratory, in which the methylation process was developed and first applied to all types of carbohydrates, has been engaged continuously for more than twelve years on the general problem now included in Prof. Haworth's reservation. The results reported by him, and others of a similar nature, have been known to us for a considerable time, but we have good grounds for the opinion that the interpretation of these results is beset with so many complications that early publication is inadvisable. At regular intervals during the past four or five years, however, the results have been communicated to the expert referees of the Carnegie Trust, which has, in part, financed the work.

In the circumstances which have emerged it appears to be desirable, in the interests of my collaborators, to synopsise, so far as this is expedient, some of the results already obtained by us.

Cellulose.—When cellulose is methylated on a large scale and the product subjected to *graded hydrolysis*, only 2 : 3 : 6-trimethyl glucose is liberated in the first instance, the 2 : 3 : 4 : 6-tetramethyl glucose being derived from the more resistant fraction of the methylated cellulose. It is still an open question if this result can be interpreted as a proof that cellulose possesses a long-chain structure, or if the amount of tetramethyl glucose formed can be used as the basis of calculating the length of the cellulose chain as a whole. This work has been conducted, with numerous variations, on cellulose derived from

five distinct sources and on material specially prepared in the Forest Products Research Laboratory.

Starch.—The corresponding results which we have obtained with starch vary according to several factors: for example, the nature of the amylose used and whether the material is methylated directly or is subjected to a preliminary acetylation. When the hydrolysis of methylated amylose is carried out in stages, tetramethyl glucose can be detected in amounts varying from 3 to nearly 5 per cent; but of much greater importance is the observation that one fraction of the methylated amylose is convertible into a mixture of sugars, the composition of which varied within the following limits:

2 : 3 : 4 : 6-Tetramethyl glucose .	23-26 per cent
2 : 3 : 6-Trimethyl glucose .	55-52 per cent
2 : 3- and 2 : 6-Dimethyl glucose .	21 per cent

This indicates that the group responsible for the formation of tetramethyl glucose forms part of a complicated fragment of the amylose complex, as otherwise no dimethyl glucose would be formed from a fully methylated derivative. We have shown that this dimethyl glucose is a mixture of 2 : 3- and 2 : 6-isomerides in approximately equal proportions when the amylose has been methylated directly; but this ratio is disturbed to 24 and 76 per cent respectively as the result of preliminary acetylation. This, in itself, indicates the extreme caution which must be exercised in applying the methylation method in conjunction with acetylation to polysaccharides.

Inulin.—Trimethyl inulin when hydrolysed with oxalic acid yields, in addition to trimethyl γ-fructoses, a mixture of (*a*) ω-methoxy-5-methylfurfural, (*b*) tetramethyl γ-fructose and (*c*) a trimethyl anhydrofructose. We find that the yields of tetramethyl γ-fructose have varied from 2·7 as a maximum to 1·7 per cent as a minimum, owing to partial conversion of the sugar into the furfural derivative. If all of the above products be calculated as tetramethyl fructose, inulin would consist of a chain of 25 fructose units; whilst taking the above yield of 2·7 per cent as a basis, the inulin molecule would contain 43 fructose units in the chain.

We have encountered so many complications in our studies of methylated polysaccharides (including the unexpected result that certain γ-fructose derivatives are readily transformed into derivatives of glucose) that we are reluctant to make far-reaching claims on the basis of having isolated such compounds as tetramethyl glucose and tetramethyl fructose under the conditions described; but this communication will serve to show the progress we have made recently in researches which were initiated in this laboratory and have not been discontinued.

J. C. IRVINE.

Chemical Research Laboratory,
The University, St. Andrews,
March 12.

Vertical Tube Counter- and the Barometric-Effect of Cosmic Radiation at Sea-level

TURNING a long tube counter in a perpendicular plane, the number of recorded cosmic ray particles depends on the angle α between the vertical direction and the axis of the tube. This vertical tube counter effect, first observed by Tuwim [1] at Potsdam, has now been measured more precisely and found to be in accordance with his theory of this phenomenon.

The number $N_{\mu H}(\alpha^\circ)$ is proportional to $\sin^2\alpha$, as shown in Fig. 1. This straight line enables the elimination of experimental errors of the single measurements, and therefore the fraction $N_{\mu H}(0^\circ) : N_{\mu H}(90^\circ)$ and the mean mass absorption coefficient of the cosmic radiation can be found more exactly than before. In a lead screen, 10 cm. thick, the coefficient was found to be $(\mu/\rho)_{H_2O} = 8{\cdot}01$ and $8{\cdot}12 \times 10^{-4}$ cm.^{2} gm.$^{-1}$ with the two tube counters No. 21 and No. 22 ($r = 2{\cdot}4$, $l = 45{\cdot}0$ cm. and 46·0 cm.) respectively, in accordance with Tuwim's value $(9 \pm 1) \times 10^{-4}$ cm.^{2} gm.$^{-1}$ obtained with tube counter No. 15 ($r = 2{\cdot}4$, $l = 15{\cdot}3$ cm.).

Repeating the experiments in the open air at different barometric pressures, the straight line of the vertical tube counter effect is shifted parallel, showing thus the barometric effect [2] very clearly. Assuming a pure absorption phenomenon for this behaviour,[3] the mean absorption coefficient is $(\mu/\rho)_{H_2O} = 1{\cdot}67 \times 10^{-3}$ cm.^{2} gm.$^{-1}$. From the vertical tube counter effect it was found to be $(\mu/\rho)_{H_2O} = 1{\cdot}69 \times 10^{-3}$ cm.^{2} gm.$^{-1}$ in the open air.

By two different methods, therefore, it is possible to measure accurately the absorption coefficient of cosmic

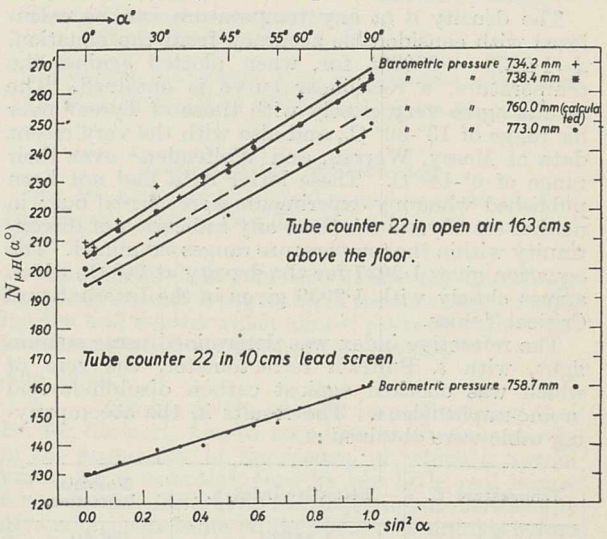

FIG. 1.

radiation with the same apparatus and at the same time, but without a special screen indispensable for the usual method of determining absorption coefficients.

The accordance of the two values for the open air confirms the theory of the vertical tube counter effect, and should be interpreted by this theory that the direction of the cosmic rays, acting in the counter, is not greatly different from the initial direction of the rays entering the atmosphere. The conflicting results of Skobeltzyn [4] with the Wilson chamber are therefore probably due to the greater statistical uncertainty of his measurements; for, according to him, no vertical tube counter effect of the cosmic radiation can exist.

W. KOLHÖRSTER.

Höhenstrahlungslaboratorium des
Meteorologisch-Magnetischen Observatoriums,
Potsdam, Jan. 31.

[1] L. Tuwim, *Berlin, Ber.* **91**, 360; 1931.
[2] L. Myssowsky and L. Tuwim, *Z. Physik*, **39**, 146; 1926.
[3] W. Kolhörster and L. Tuwim, *Erg. kosm. Physik*, **1**, 127; 1931.
[4] D. Skobeltzyn, *C.R.*, **194**, 118; 1932.

Molecular Refraction of Nitrobenzene

THE discontinuities observed by Mazur in certain physical properties of nitrobenzene in the neighbourhood of 9·5° C., and described in a series of communications to NATURE, call for further investigation. The sharp decrease in the dielectric constant [1] at 9·6° C., the distinct retardation in the heating curve [2] at 9·5° C., and the change in slope of the density-

temperature curve [3] at the same point suggest the existence of two forms of nitrobenzene.

It seemed of interest to ascertain if any change in molecular refraction is observable in the neighbourhood of this temperature. Having a supply of B.D.H. 'purified nitrobenzene' at my disposal, it was decided to carry out a few tests with it. It melted sharply at 5·3° C., a temperature 0·2° below that of Mazur's specimen. Its density (in air) was determined pycnometrically, with the following results:

t °C.	Density.	t °C.	Density.
6·6	1·2168	15·4	1·2082
8·0	1·2159	24·4	1·1994
11·0	1·2127	26·1	1·1977
11·4	1·2122	29·6	1·1943
13·4	1·2101	..	..

The density d at any temperature can be calculated with considerable accuracy from the equation, $d = 1·2233 - 0·00098t$, for, when plotted against the temperature, a rectilinear curve is obtained. The results agree very closely with those of Tyrer [4] over his range of 13°-30° C., and also with the very recent data of Massy, Warren, and Wolfenden [5] over their range of 6°-14° C. These latter data had not been published when my experiments were carried out; in neither set of results is there any indication of discontinuity within the temperature ranges examined. The equation gives 1·2037 for the density at 20° C., which agrees closely with 1·2039 given in the International Critical Tables.

The refractive index was determined using sodium light, with a Pulfrich refractometer, the zero of which was checked against carbon disulphide and bromo-naphthalene. The results in the accompanying table were obtained:

Temperature °C.	Refractive Index, n.	Molecular Refraction.
6·4	1·55972	56·60
8·6	1·55893	56·62
9·2	1·55858	56·61
10·5	1·55786	56·60
13·5	1·55653	56·60
15·1	1·55565	56·59
20·6	1·55299	56·57

The value for n at 20·6° closely approaches the value 1·55291 for 20° given in the International Critical Tables (vol. 7).

The third column gives the molecular refraction calculated from Gladstone and Dale's formula, $\frac{M(n-1)}{d}$, where M is the molecular weight, taken as 123·07, and d the density as calculated with the aid of the equation given above.

The molecular refraction shows merely a minute and steady change with the temperature, amounting in all to approximately 0·1 per cent. These results, coupled with those of Massy and his co-workers, indicate that ordinarily 'pure' nitrobenzene exhibits no apparent discontinuities in such physical properties as have been examined in the neighbourhood of 9·5° C. To what cause, then, may the remarkable observations of Mazur be assigned?

J. NEWTON FRIEND.

Technical College, Birmingham,
Feb. 4.

[1] Mazur, NATURE, **126**, 993; 1930.
[2] Wolfke and Mazur, NATURE, **127**, 741; 1931.
[3] Mazur, *ibid.*, p. 893.
[4] Tyrer, *Trans. Chem. Soc.*, **105**, 2544; 1914.
[5] Massy and others, *J. Chem. Soc.*, 91; 1932.

Hyperfine Structure of the Mercury Line 5471 A.

IN an attempt to explain the observed complicated structure of the mercury arc lines, Venkatesachar and Sibaiya [1, 2] first suggested nuclear moments of 1/2 and 3/2 for the various isotopes of mercury. More recently, Schuler and Keystone [3] in Germany and Murakawa [4] in Japan have explained the structure of some prominent mercury arc lines by ascribing a nuclear moment of 1/2 to the odd isotope with atomic weight 199 and 3/2 to that with 201.

Though the mercury arc lines have been analysed by a number of investigators, a re-examination of the lines has revealed in some cases the indubitable existence of satellites that have not been previously recorded. It is realised that one has to be very cautious before being certain of the existence of new satellites, often faint, in the case of lines that have been carefully examined by others. It is concluded, however, that even the line 5461 ($6\,^3P_2 - 7\,^3S_1$) has undoubtedly one more satellite at $-0·154 \pm 0·002$ A. The structure was examined in a low density, long column mercury arc, using as the resolving apparatus fused quartz etalon plates (specially made by Messrs. Adam Hilger, Ltd.) of 2 mm. and 3 mm. thickness, suitably silvered on both sides. The microphotometer record (kindly taken by Messrs. Carl Zeiss) of the pattern obtained by using the 3 mm. etalon reproduced in Fig. 1, shows clearly the position of the new satellite. Besides, the existence of a satellite in this region has been suspected by Luneland [5] so early as 1911, and later by Schrammen [6] in 1927. But so definite a satellite does not work into the Schuler-Keystone scheme even as a forbidden satellite.

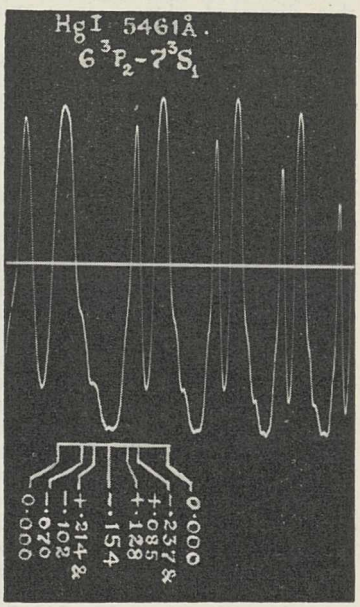

FIG. 1.

Again, the line 5770 ($6\,^1P_1 - 6\,^3D_2$) has shown a structure containing three additional satellites at $-0·173$, $-0·213$, and $-0·257$ ($\pm 0·003$) A. These new satellites for 5770 along with the complex structures of 4916 ($6\,^1P_1 - 8\,^1S_0$) and 5026 ($6\,^1P_1 - 7\,^3S_1$), recently given by Venkatesachar and Sibaiya,[7] indicate that the common level $6\,^1P_1$ is more complicated than is assumed by Schuler and Keystone.

L. SIBAIYA.

Central College,
University of Mysore,
Bangalore, Feb. 12.

[1] *Mys. Univ. J.*, **4**, 145-148; 1929.
[2] Sibaiya, "Revision of the Hyperfine Structure Data of some Prominent Mercury Lines" (abstract), 19th Ind. Sci. Cong., 1932.
[3] *Z. Phys.*, **72**, 423-441; 1931.
[4] *Z. Phys.*, **73**, 366-375; 1931.
[5] *Ann. Physik*, **34**, 505; 1911.
[6] *Ann. Physik*, **83**, 1161-1199; 1927.
[7] *Naturwiss.*, **19**, H. 52, S. 1041-1042; 1931.

Hibernation of Adders

THE hibernation of adders and the mechanism of the process are very little understood. To all intents and purposes there is an apparently complete suspension of vital activity, but from the biological point of view this cannot be, as the nutrition of the body tissue must go on. Recently while engaged in dissecting an adder, I preserved a portion of the lung tissue and had it sectioned in the usual way. Microscopic examination of several sections showed extensive deposits of adipose tissue immediately surrounding the tracheal ring. Similar islets of fatty substance were seen round the bronchi and bronchioles, and there was an extension of this type of tissue round the terminal

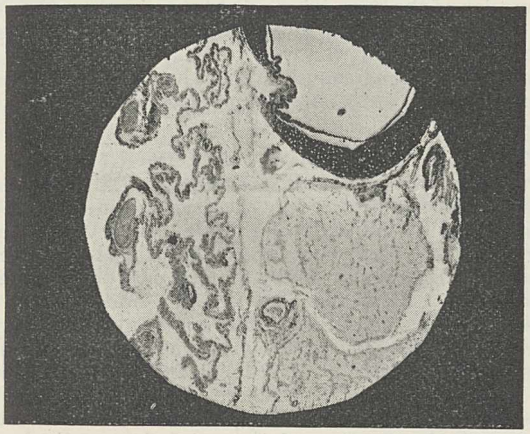

FIG. 1.—Adder lung showing adipose tissue round tracheal cartilage. Photograph by N. Morrison.

alveoli and in the substance of the lung (see Fig. 1). This appeared to me to be unusual, as one does not find adipose tissue in the lung of animals.

There is a possibility that for hibernative purposes Nature is capable of converting the interstitial tissues of the lung into adipose tissue. A good supply of fat ensures for the hibernating animal two things, namely:

(1) The possession of warmth for the organism.

(2) A reserve supply of energy when all other centres are exhausted.

Fats are eminently suitable for the incalculably slow process of oxidation which goes on when respiration is almost suspended, during the process of hibernation. One can compare hibernation with a slow smouldering fire. It lasts as long as there is a combustible material. If that material is easily consumed, the fire will soon come to an end. If, on the other hand, the material is good fuel but burns slowly, the fire will keep going so long as Nature wants it. Fatty tissue serves Nature's purpose admirably in this direction, and my examination of the microscopic slides gave me the impression that the presence of so much fat in the pulmonary tissue was meant to give it the central control of hibernation. N. MORRISON.

Behaviour in Invertebrates

A RECENT paper by Southern and Gardiner [1] on the diurnal migrations of the Crustacea of the plankton in Lough Derg shows once more that observations by different workers on the behaviour of the same species of plankton animals are in many cases not in agreement. I have previously shown [2] that the copepod *Calanus finmarchicus* apparently behaves differently at one time of the year from another; this difference is, in a way, only *apparent*, as we are comparing individuals that are not strictly comparable, namely, *different broods* which have grown and developed under different conditions. If we compare the behaviour of similar broods from year to year, they appear to be the same. Is not this a side of the problem that has been rather overlooked in the past?

In comparing the behaviour of short-lived species from place to place, the comparison must be made between comparable broods that have developed under the same conditions. I have recently been able to show that there are possibly five distinct broods of *Sagitta elegans* during the year in the waters of the English Channel off Plymouth. Each of these broods is born and develops under different conditions brought about by seasonal changes. It is only natural to expect, therefore, that the individuals of each brood will have their own type of behaviour and seek optimum conditions that are different for those of other broods. F. S. RUSSELL.

Marine Biological Association,
Plymouth, Feb. 17.

[1] Southern, R., and Gardiner, A. C., *Proc. Roy. Irish Acad.*, vol. 40, section B, No. 11, pp. 121-159; 1932.
[2] *J. Mar. Biol. Assoc.*, N.S., vol. 15, No. 2, pp. 429-454; 1928.

Plato and the Modern Age

MR. W. G. LINN CASS, in his review of Mr. Lowes Dickinson's "After Two Thousand Years", remarks [1] that:

"The extraordinary increase in scientific knowledge has vastly extended the realm of thought and revealed heights and depths which almost make the mind reel in contemplation of the physical universe."

And again:

". . . turning to the thinker himself we find that he, for his part, has to spend so much time merely in the acquisition of knowledge, of which a certain minimum is essential, that he has little real leisure for serious meditation on the majestic but increasingly mysterious panorama of life which now unfolds before him."

These propositions seem to me to confuse the thinker with his telescope and even to suggest that it assembled its own parts. As a mere question of fact there is nothing 'reeling' in the mind of Sir James Jeans, for example, and no conspicuous lack of leisure for comparatively serious meditation in the many readers and listeners-in before whom he has displayed some of the mysteries of the universe. But is there not a deeper fallacy? Does the increase in scientific knowledge and the increasingly mysterious panorama of life really affect the mind of man in the sense indicated by Mr. Linn Cass? If there were not this increase, the mind would decline in power. Its vigour is maintained at the same high level by the constant addition to the material of knowledge. The Hebrew star-gazer, who never held a telescope in his hand, wrote of 'the stars in their courses' with an astonishment not less than that of the astronomer of to-day. "We begin to see how insignificant our home in space really is", says the latter on page 117 of his book of that name; and the former said: "When I consider . . . . . the stars, . . . What is man, that thou art mindful of him?" Five billion years hence (if that is the correct figure) the new astronomer may be saying it again; and, haply, he will still refuse to be defeated by the contemplation of the physical universe, and will still contrive a foundation of faith on which to build his seat of knowledge among the stars. LAURIE MAGNUS.

34 Cambridge Square, W.2,
March 15.

[1] NATURE, **129**, 381, March 12, 1932.

Research Items

Inheritance of Mental Defect.—Mental deficiency, its causes and inheritance, has recently been discussed by Prof. F. A. E. Crew (*Eug. Rev.*, vol. 23, No. 4), who points out the well-known difficulty in defining accurately, from a biological, psychological, or even legal, point of view, the various types of mental aberration. Idiocy, imbecility, and mental deficiency are not a biological classification of types, nor are the grades of mental defect genetically classified by drawing the line of normality at a particular intelligence quotient. In many instances, hereditary transmission is operating, but there are different genetic types of mental defect. In certain cases, amentia appears to be a single recessive genic character. This type should show a higher incidence in cousin marriages. Other pedigrees show ordinary dominance of the inherited mental defect with a high incidence in the family. In other cases, the method of inheritance requires an explanation by sex-linkage or multiple recessive factors, or a dominant gene together with a dominant inhibitor. The nature of the defect will also differ in families, because any abnormality of the brain may result in a mentally deficient condition. References are also made to primary and secondary ('acquired') amentia and to the influence of the uterine environment and order of birth in amentia and Mongolism.

Iroquoian Origins.—Dr. W. D. Lighthall has communicated to the Royal Society of Canada (*Trans. Roy. Soc. Canada*, series B, vol. 25, sect. 2) a study of the affinities of the culture of the Iroquois, in which he arrives at the conclusion that the Iroquois were intrusive in North America, reaching it from South America by way of the West Indies, and that ultimately the stock was of Melanesian origin. It is pointed out that the early situation of the southern Iroquois was largely within reach of the Atlantic by way of rivers, and precludes all theory of a south-western or Mound Builder origin. Their distribution points to a derivation from the West Indies, where Arawak and the later Carib culture presents affinities to the great Guarani stock of South America. Points in Carib culture to which attention is directed with regard to the Iroquois are the organisation of the people of Guiana into five closely allied tribes or nations each with its own council, the construction of their towns on rivers or lakes, absence of domestic animals and dependence on hunting, the use of arrow and blowpipe, type of canoe, the election and position of the chief, and descent in the female line. It is pointed out, further, that the Iroquois are of a tropical and islander character. In the use of a raised bed-platform, blow-gun and bow, the hammock, the double-headed maize pestle, the elaborate body-painting and tattooing, incised patterns on their pottery, and their long houses, they show resemblances to the Guarani. As regards Melanesia, attention is directed to the resemblances which Dr. Rivet has found between Melanesian skulls and certain ancient American types, while Prof. Dixon has pointed out the peculiar and primitive type of the long-headed Iroquois skulls. The tattooing and pottery ornament are held to be of Melanesian, and possibly ultimately of African, origin.

Articulation of Joints in the Bat.—A photograph accompanying a note by Mr. J. H. Vickers in the *Field* for Feb. 20 (p. 264) affords a correction and explanation of an error which is constantly repeated even in works of unexceptionable scientific authority—that the knee in bats is so rotated outwards by the wing-membrane that it is directed backwards like the elbow. The illustration referred to represents a long-eared bat crawling in the upside-down position, with the left leg flexed at the knee and ankle in the same way as it would be by any other plantigrade mammal, although the foot is merely turned outwards and not forwards; the right leg is stretched out straight, with the toes pointing backwards and the knee upwards, which gives the elbow-like effect. The fact is that the freedom of action in the hip and ankle-joints in the bat is so great that the leg has more than the play of the human arm, and functions as an arm to such an extent that it is easy to see how the idea of the reversion of the knee-joint gained currency; especially as the bat can crawl in any direction, and is rarely seen on the flat in the quadrupedal position, though some illustrations show it thus, the pose of the hind limbs being merely an exaggeration of the straddle of the squirrel's.

The Grass Embryo.—Dr. Lucy Boyd (*Trans. and Proc. Bot. Soc. Edinburgh*, vol. 30, part 4, pp. 286-303) has raised again the controversial question of the homologies of the parts of the grass embryo, putting forward the view that the coleoptile is the first plumular leaf, whilst the epiblast is part of a vestigial ligule of the cotyledon, the opposite side of which is fused with the scutellum. Her views appear to have originated mainly from a consideration of evolutionary trends in Monocotyledons, the interpretations so suggested being supplemented by anatomical investigation. The series of types selected to illustrate the gradual reduction of the cotyledonary ligule to the final condition existent in the Gramineæ is well chosen and suggestive. The evidence for the foliar nature of the coleoptile is less convincing. It is true that the derivation of the vascular supply to the coleoptile from the scutellum does not eliminate this interpretation, but, on the other hand, the same facts would apply if the coleoptile were regarded as part of the much modified cotyledon. Further facts are required before an agreement on this much-discussed question is likely to be general. It seems probable that a detailed comparison of the embryos from the earliest stages of development is most likely to give facts which may lead ultimately to a satisfactory interpretation.

Permian of Texas.—The Permian System in Trans-Pecos Texas shows a more complete development than in any other part of North America, and is regarded by R. E. Evans ("Geology of the Glass Mountains", Texas, part 2; *Univ. Texas Bull.*, 3042, 1930, pp. 245, pls. 44) as one of the standard sections of the Permian rocks of the world, comparable with the sections in the Salt Range of India, the island of Timor, and the Urals. In Texas the most complete Permian section is in the Glass Mountains, north of Marathon, where the system is represented by 7000 feet of strata divisible into six formations. A summary of the stratigraphy and palæontology is given, but the main part of the work is devoted to a description of the brachiopods, of which 185 species and varieties, belonging to 47 genera, are recognised. These belong mainly to the Protremata and Telotremata; the Atremata are not represented, and only two forms of the Neotremata were found. The presence of the families Richthofeniidæ and Lyttoniidæ, and the abundance of the Productidæ, are the most striking features in the brachiopod fauna.

Pleistocene Climates of North China.—Prof. G. B. Barbour has published a valuable paper on this

subject (*Bull. Geol. Soc. China*, vol. 10, pp. 71-104 (Grabau Anniversary Volume)). A brief description is given of fossiliferous continental deposits of late Pliocene and early Pleistocene age discovered near Taiku, Shansi. The contrast in character between the lower and upper members of the series points to a distinct change in conditions of weathering and throws new light on the climatic fluctuations. Three schemes of stage correlation with European stages are discussed, and the conclusion is reached that the facts are inexplicable without appeal to a shift of the earth's axis of rotation. The problems raised by each hypothesis are considered and directions suggested which may lead to a solution. Meanwhile it seems clear that the evidence is in close accord with Simpson's radiation control hypothesis, and that the warm climate inferred from the fossils and lithology of the Taiku beds supports the Wegener-Köppen hypothesis of polar shift. Dr. D. Black in a paper on "Palæogeography and Polar Shift" in the same journal (pp. 105-57) also adduces evidence favouring acceptance of the Simpson and Wegener-Köppen hypotheses. He writes: "The same set of hypothetical considerations as give adequate explanation of the extraordinarily varied Quaternary climatic conditions known to have obtained in North and South America, in Europe, Australia, Tasmania, and New Zealand, would seem in turn to yield equally satisfactory explanation for the peculiarly different climatic conditions characterising Asia during the same period". The paper is illustrated with twenty-six maps of the world representing the longitudes and latitudes corresponding to seven selected points on the assumed trajectory of the shifting pole.

The Formation of Alto-cumulus Clouds.—In a note on alto-cumulus cloud by C. S. Durst in the *Meteorological Magazine* for January 1932, new light appears to be thrown on the physical processes involved in the formation and maintenance of this type of cloud. Mr. Durst was led to consider the probable origin of the instability necessary for the formation of such convectional clouds with their bases at a great height above the earth's surface. It seemed to him probable that a combination of loss of heat by radiation from the tops of the clouds and gain of heat at their bases by radiation from the earth and the atmosphere below the clouds, might yield the simplest explanation. But there is the difficulty that alto-cumulus should according to this hypothesis be more frequent at night than by day, because of the considerable insolation usually taking place on the upper surface of the cloud during the day, which appears to be flatly contradicted by Russell's observations on the diurnal variation of frequency of these clouds in southern England. Durst has, however, found that Russell's figures, showing a marked minimum around 1 A.M. and 2 A.M., are greatly affected by the frequent difficulty of seeing alto-cumulus at night when it is present. When due allowance is made for this, it appears that the frequency at night is in all probability between two and four times as great as it is by day.

Absorption of Hard γ-Radiation.—Two exceedingly careful studies on the absorption of γ-rays are reported in the February number of the *Proceedings of the Royal Society*. One by C. Y. Chao is concerned with the variation with wave-length of the absorption in lead. It establishes that there are abrupt changes at about 6 X.U., the absorption passing through a minimum value, and the conclusion is drawn that this is connected with the existence of an excitation or disintegration potential for the lead nucleus. The other, by G. T. P. Tarrant, deals with the variation with atomic number of the absorption coefficient for the monochromatic γ-rays from one of the members of the thorium family of elements. The curves expressing the results are more regular and comprehensive than those of earlier investigators, and agree with the best of these. For the light elements the absorption coefficients appear to be a little greater than would be expected from the theory of Klein and Nishina, but the origin of the discrepancy is not certain. For the heavy elements there is definitely extra absorption, and it seems now to be generally agreed that this represents in part a nuclear phenomenon, although the nature of this is not indicated so clearly by Tarrant's work as by Chao's.

Cathode-ray Oscillographs.—The importance of the cathode-ray tube as an instrument for measuring electrical quantities is a good example of the assistance that pure physics is constantly giving to electrical engineering. It also shows that unless the principles underlying the operation of the apparatus are clearly understood, erroneous conclusions may be drawn from its readings. At the Institution of Electrical Engineers on Feb. 5, two papers were read on these instruments. The first, by Dr. A. B. Wood, dealt briefly with some of the more important developments in their design and use. He considers that, of the various methods for focusing the cathode stream, the electrostatic method gives the best results. The recording of the effects of lightning is a difficult matter, owing to the uncertainty in the time of the arrival of the impulse. The timing in this case has to be automatic, the lightning impulse itself initiating the time deflexion of the cathode-ray spot. The second paper, by Prof. MacGregor-Morris and H. Wright, discusses possible sources of error in using these instruments for measuring purposes. Modern tubes have seldom serious faults due to defects in manufacture. The authors discuss the supposed 'threshold' effect. This effect, as generally stated, is that a definite value of the deflecting voltage has to be reached before any deflexion takes place. Their results show that this is only approximately true, as the sensitivity, although it is smaller, is not zero for small deflecting forces. For electromagnetic deflexions, no such effect was observed. Stress is laid on the necessity of calibrating the tube accurately. This should be done photographically, and should be carried out over the greater part of the surface of the fluorescent screen and not merely for two lines at right-angles to one another.

The Determination of Nitrogen Peroxide.—E. J. B. Willey and S. G. Foord have described a new and rapid method for the determination of nitrogen peroxide (*Proc. Roy. Soc.*, Feb.). White light from a constant source is filtered to give a narrow band of wave-lengths, then passed through an absorption tube holding the mixture to be analysed, and finally received on a photoelectric cell. From the current passed by the cell, which is measured by a Wynn-Williams valve bridge, the intensity of the light falling on the cell, and hence the amount of absorption by the peroxide, are determined, and from a preliminary calibration with known amounts of peroxide the amount of this present is then known. The device may be used for concentrations of $1:10^5$ and upwards. It has a number of interesting uses, including the regulation of temperature and pressure by a thermostatic control actuated by a variation in current through the cell caused by a shift in the equilibrium between the simple molecule (NO_2), which is transparent, and the coloured polymer (N_2O_4).

Optical Activity in Diazo-Compounds.—Although optically active diazo esters containing only one

possible asymmetric carbon atom bound to the diazo group have been prepared, their specific rotations are small, and compounds with large rotations previously obtained contain another asymmetric carbon atom and are very unstable. Suggestions have been made that the diazo esters have a ring structure. Ray (*J. Amer. Chem. Soc.*, Jan.) has now prepared a stable, optically active, crystalline aliphatic diazo-compound, β-naphthol-phenyldiazomethane, melting at 120° and having a high specific rotation, which shows that a carbon atom attached to the diazo group may retain its asymmetry. The compound was prepared from the active forms of the amine, β-naphthol-phenylaminomethane, by dissolving this in pyridine and, after addition of sodium nitrite, adding to cooled concentrated hydrochloric acid, when the diazo compound separated in light flaky lemon-yellow crystals. Its formula is decided by the fact that treatment with alkali does not racemise the compound, so that the diazo group and carbon atom are in a straight chain, the pentad nitrogen losing an electron to the carbon, to which it is otherwise united by an electron pair.

Preservation of Railway Sleepers.—In *Forest Bulletin* No. 74 (Economic Series), 1931, Mr. F. J. Popham summarises the results of laying treated experimental sleepers in the various railway systems of India. The author states that it is now recognised that the open tank treatment given in the majority of the earlier tests is inadequate, and that treatment in a pressure plant, with the specification worked out for each species, will give better results. Apart from one or two instances in which the iron pot sleeper was made use of, most of the premier Indian Railway main lines, when their first construction was undertaken during the 'sixties and 'seventies of last century, made use of either deodar, teak, or sâl, the three chief timbers in common use in the country. The investigations into treated sleepers are concerned with other Indian timbers and the experiments here dealt with are confined to the five species *Pinus longifolia*, *Pinus excelsa*, *Dipterocarpus tuberculatus*, *Dipterocarpus alatus*, and *Terminalia tormentosa*. The preservatives used were carbolineum avenarius, zinc chloride and carbolineum avenarius, Powell's solution, and solignum and earth oil. So far the dipterocarps have been failures, whilst Powell's solution appears unsuitable in damp conditions, being subject to leaching. As was to be expected, certain anomalies have become apparent in the different tests, which further investigations will probably elucidate. An examination of the results in the Karachi division is of interest. The sleepers (the two pines and *Terminalia*) were Powellised and laid down in the main line in 1911. They were removed from the line in 1922, many of them suffering from rot. The best of these were selected and relaid in Palidan's goods yard in 1922 and have given excellent service since. In all probability they would have been removed from the main line by now owing to mechanical failure, but their life indicates their durability, so far as white ant and fungus attacks are concerned, when placed in a dry area.

Astronomical Topics

Conjunction of Venus and Mars in A.D. 864.—NATURE for Nov. 28, 1931, contained an article by Mr. J. H. Reynolds in which mention was made of an observation made by Habash at Baghdad of an extremely close conjunction of the above planets; the date is given by Mr. Reynolds as Oct. 10, but calculation by Dr. A. C. D. Crommelin shows that it should be Oct. 21 astronomically reckoned, or the morning of Oct. 22 civil. The calculation was made for Oct. 21·64 G.M.T., which is the time of sunrise at Baghdad; the accelerations adopted by Dr. Fotheringham and Herr Schoch were applied to Newcomb's tables; the centennial values are 2·472″, 1·521″, and 0·8087″ for Venus, earth, and Mars respectively. The conjunction in longitude occurred about twelve minutes after sunrise, Mars being 104″ north of Venus. It would have been more than an hour after sunrise if the accelerations had not been applied; hence the phenomenon gives support to the accelerations. Mars was 2·22 units from the earth, hence it would be rather faint, and would probably not be visible later than twenty minutes before sunrise, at which time the distance between the planets would be about 2′. The distance between the components of the 'double-double' epsilon Lyræ is 3½′, and it needs an acute eye to divide it; it is doubtful whether any eye could separate Venus and Mars at a distance of 2′; the calculation vindicates the accuracy of Habash's statement that they came so close as to appear one planet.

The Orbit of 61 Cygni.—The *Observatory* for February contains a letter from Mr. A. Fletcher on the subject of the orbit that he has lately calculated for this star. The difficulty in this case is to determine the inclination of the orbit-plane to the line of sight, owing to the shortness of the arc covered by good observations, compared with the whole orbit. Since the parallax is very well known (Prof. Schlesinger adopts 0·300″ ± 0·003″) and the absolute magnitudes are thereby determined, Mr. Fletcher derives the masses from the mass-luminosity law; this gives the inclination, and the other elements follow. Their values are given in *Monthly Notices* of the Royal Astronomical Society for December as follows: Period 696·63 years, periastron passage 1686·37, a 24·525″, e 0·40369, i +52·896°, ω 153·917°, Ω 172·823°.

Peters' orbit, published in *Astr. Nach.* in 1887, gave the period as 783 years from a much shorter arc, so there is good reason for hoping that the new period may be in the neighbourhood of the truth.

Report of the Naval Observatory, Washington, for 1931.—The six-inch transit circle was in use for observation of the sun, moon, planets, and fundamental stars, also for the Eros-comparison stars; Eros itself was observed 28 times on the meridian. A Shortt clock was received in November 1930, and was in use for most of 1931. Its rate was steady; there is a temperature variation of 0·07 sec. per day per degree centigrade, but as the temperature is kept very nearly constant, this is not important. A new clock vault will contain piers for seven clocks. With the 26-inch equatorial, Eros was observed 101 times; the satellites of Saturn on 28 nights. Sixty-five photographs of Eros were obtained with the 12-inch equatorial, using a yellow screen, as the objective is a visual one. Stars of magnitude 10 need an exposure of one minute; those of magnitude 14 need an hour. The sun was photographed on 303 days with the photoheliograph; spot activity continues to decrease, and the minimum is expected in 1933 or 1934.

In the Nautical Section it is noted that instruments have been constructed that give a continuous record of the direction of a ship's course as determined by the gyrocompass, with an accuracy of one-tenth of a degree; also instruments for giving a dead-reckoning position of the ship.

International Atomic Weights *

TWO changes in the table of atomic weights are recommended by the Committee on Atomic Weights of the International Union of Chemistry in its second report, which has just been published; the atomic weight of krypton is considered to be 83·7 instead of 82·9, and of xenon 131·3 instead of 130·2. The Committee, which consists of Prof. G. P. Baxter (Cambridge, Mass.), Mme. P. Curie (Paris), Prof. P. Lebeau (Paris), and Prof. R. J. Meyer (Berlin), reports on all the atomic weight investigations published during the period Feb.–Oct. 1931 which have come to its attention; future reports will cover a period of twelve months. Authors of papers bearing on the subject are requested to send copies to each of the five members of the Committee at the earliest possible moment.

Elements of which the atomic weight has been determined during the period under review by physico-chemical methods are: nitrogen, carbon, sulphur, fluorine, krypton, and xenon; chemical methods have been applied to the study of nitrogen, silver, chlorine, and iodine; physical (mass-spectrograph) measurements have been applied to the calculation of values for lithium, cæsium, boron, germanium, selenium, tellurium, tungsten, bromine, rhenium, ruthenium, and osmium, whilst a new determination of the relative proportions of the oxygen isotopes has been made by microphotometric evaluation of the band spectrum of oxygen.

Reference should first be made to the investigation last mentioned, because the results provide a new conversion factor for the calculation of 'chemical' atomic weights from 'physical' atomic weights, and emphasise the disparity between the two scales for the determination of atomic weights used respectively by chemists and by physicists. This "undesirable situation" arises from the fact that the chemical unit, O = 16, takes no account of the existence of the three isotopes of oxygen, O^{16}, O^{18}, and O^{17}, present, according to Mecke and Childs, in the ratio $630 \pm 20 : 1 : 0{\cdot}2$. The physical unit is referred to the isotope O^{16}, and hence the two scales differ by one or two parts in ten thousand. The propriety of employing hydrogen, helium, or O^{16} as a chemical standard has therefore been canvassed, but in Dr. F. W. Aston's opinion, communicated to the British Association last year, the present chemical standard amply satisfies all requirements of international atomic weights so far as accuracy is concerned. The Committee agrees unanimously with Dr. Aston, and therefore does not propose a departure from the existing unit. The new conversion factor is 1·00022, whilst the Naudé factor, at present in use, is 1·000125.

Nitrous oxide has been found by Batuecas to have a normal density of $1{\cdot}98042 \pm 0{\cdot}00005$ (not 1·98038 as given in the original), this value being the mean of twenty determinations. Cooper and Maass report values of 44·0054 and 64·059 for the molecular weight of carbon dioxide and sulphur dioxide respectively, leading to atomic weights of 12·0054 for carbon and 32·059 for sulphur. Patterson, Whytlaw-Gray, and Cawood, repeating the work of Moles and Batuecas, find the molecular weight of methyl fluoride to be 34·046, and are of opinion that the true atomic weight of fluorine lies nearer to 19·010 than to 19·000 (see NATURE, **128**, 375), despite Aston's view that fluorine is a simple element. By comparison of the densities of krypton and oxygen, Watson calculates the atomic weight of krypton to be 83·71, whilst Whytlaw-Gray, Patterson, and Cawood, by comparison of the pressures at which xenon and oxygen possess the same density, find the atomic weight of xenon to be $131{\cdot}26 \pm 0{\cdot}005$.

Gravimetric determination of the ratio $Ag : NH_3$ by Baxter and Greene, combined with the ratio $Ag : NO_3$, gives, when chloride or dilute bromide solutions are used, the value 14·0078 for the atomic weight of nitrogen. Hönigschmid corrects the results of silver chloride analyses by Hönigschmid and Bedr Chan, and obtains a mean atomic weight for chlorine of $35{\cdot}456_3$ (gravimetric) or $35{\cdot}456_7$ (nephelometric). Thermal decomposition of iodine pentoxide, employed by Baxter and Butler, leads to the low value I = 126·905, and the method is considered to be insufficiently precise. Combination of the ratios $2Ag : I_2O_5$ and $I_2 : I_2O_5$ affords the value 126·929. Determinations of the ratio AgI : AgCl by Hönigschmid and Striebel give the low value 126·917 (Cl = 35·457). Aston's value, 126·932 ($O^{16} = 16$), corresponds with a chemical atomic weight of 126·918 or 126·905, according to the conversion factor employed, but is a mean of observed limiting values 126·907 and 126·957.

Calculation of atomic weights from mass spectra, using Naudé's equation, leads to the following results (O = 16): lithium 6·923, cæsium 132·91, boron 10·806, germanium 72·65, selenium 78·96, tellurium 128·03, tungsten 183·96, bromine 79·916, rhenium 186·22, ruthenium, 101·1, osmium 190·31.

* Union Internationale de Chimie. Table internationale des poids atomiques. Deuxième rapport de la Commission des poids atomiques, 1932. (Paris: U.I. de C., 49 Rue des Mathurins.)

Co-operation in Fisheries Investigations *

THE twenty-fourth annual meeting of the International Council for the Exploration of the Sea was held in Copenhagen in March 1931. During the short interval of nine months between this meeting and the last, the general lines of work and instructions laid down by the Council have been followed. Three special conferences took place during the year, the first and second at Lowestoft, on the transplantation of plaice and on herring investigations, the third at Lisbon, on the sardine fisheries.

In reviewing the general work already accomplished, it is shown that striking progress has been made in the 'technique' of prognostication of the fisheries. In the administrative report of the Committee of the Northern North Sea, the chairman is able to state with regard to the haddock that the work has reached the stage where the yield of the North Sea haddock fisheries for eighteen months or two years ahead can be anticipated with great accuracy. The report of the Southern North Sea Committee records, not for the first time, a successful forecast of the East Anglian herring fishery; and the report of the North and Western Area Committee records the complete justification of a forecast made in the previous year of the trend of the Icelandic cod fishery.

Extensive cod-marking experiments are being carried out by Denmark in Greenland and Iceland and show an interchange between cod populations

* Report of British Delegates of the Meeting of the International Council for the Exploration of the Sea, held at Copenhagen, March 23–28, 1931. Drawn up by Henry G. Maurice and D'Arcy W. Thompson. Pp. 9. (London: Ministry of Agriculture, 1931.)

of Davis Straits and Iceland, the cod populations of Iceland being thought previously to be self-contained.

This year is the second International Polar Year, when polar hydrographical conditions will be specially investigated by all nations. It is hoped that intensive observations will be made of internal waves in the Southern Cattegat during a period of seven days in August. The English hydrographic programme includes an extension of the total current measurements which have been carried out at the Varne Lightship in the past.

The question as to whether the Limnological and the Plankton Committees should remain as separate entities was discussed, and it was decided to reconsider this at the next meeting.

Special scientific meetings on plankton and hydrology dealt with the conditions of plant life in the sea. Prof. Gran, as chairman of the Plankton Committee, reviewed recent work on the effects of phosphates and nitrates on the growth of plankton. From his own work he inclines to the belief that manganese and iron derived from coastal waters are necessary, in addition to phosphates and nitrates, for planktonic growth in Atlantic waters.

Dr. Henry Bigelow, of Woods Hole Oceanographical Institution, attended the meeting as a visitor and outlined plans for future work in the North Atlantic in which the North American Council on Fisheries Investigations might co-operate with the International Council. The Council expressed appreciation of the work to be carried out on the western side of the Atlantic, and declared that the moment is opportune to enter into close co-operation with both the Woods Hole Institution and the North American Council of Fisheries Investigations, and that this can best be achieved by close personal touch between the workers. The Council invite representatives of both bodies to take part regularly in its deliberations, in order to arrive at unity of plan and methods in the study of those fundamental problems which are similar or identical on both sides of the Atlantic.

The conclusions of the delegates are that the organisation is on a thoroughly sound footing; that its reputation in the scientific world has grown and continues to grow; that the welfare of the fishing industry demands the continuance of scientific investigations, and that the Council should be encouraged to continue its useful work.

Forestry in Trinidad and Tobago *

THE keynote of the Annual Report of the Forest Department of Trinidad and Tobago (Trinidad, May 1931) is to be found in the opening paragraph on "Forest Resources". The conservator, Mr. R. C. Marshall, is able to write: "As a result of a considerable amount of detailed field work during the last few years, we are now in a position, in regard to a considerable area of forest, to be able to substitute a clear picture of the stand of timber for the vague general idea with which, in the past, we have had to be content". Unfortunately, in far too large a proportion of the Empire forest departments this vague general idea of the forest resources still persists. The survey of the forests in Trinidad is being effected by the well-known method of running lines in carefully considered directions 100 chains apart and enumerating the trees on the lines, thus obtaining a one per cent enumeration; 6000 chains of lines were run in 1929 and 5600 in 1930.

From the enumeration surveys already made, it is now established that the Colony's 600,000 acres of forest contain a very large amount of wood. This is supported by the stock-taking effected on 1000 acres of mora (*Dimorphandra mora*) in Mayaro, and on 1000 acres of mixed forest in the Central Range Reserve, in which crappo (*Carapa guianensis*) and guatecare (*Lecythis lœvifolia*) form the most plentiful of the useful species. Appendix D gives the data of the species found on these two areas and is of great interest. It has established the fact that the mora forest in its constitution is far more comparable with the pure forests of temperate regions, which provide the bulk of the timber of commerce. It is considered possible, therefore, that this type of forest gives possibilities of regulated commercial working or 'lumbering' in the Colony. These two types of forest are representative of a large proportion of the forests of the Colony. "Increased utilisation of our forest resources", writes the Conservator, "hinges mostly on getting together stocks of timber and seasoning them properly." In view of the fact that the Colony imported £233,000 of forest produce during the year, this rightly forms one of the problems which is receiving the closest consideration.

The two most popular woods in the Colony are said to be cedar (*Cedrus mexicana*) and balata (*Mimusops balata* var. *Cruegeri*). The enumeration surveys have shown the very small proportion which these species bear to the total crop, and that the younger age classes are very deficient. It is with satisfaction that we read that working plans are being prepared, and that in the case of cedar they prescribe and control the yield. Other plans are in course of preparation, one for the control of the mangrove swamps close to Port of Spain, which are a very important source of fuel wood for the city.

The Report is replete with details of progress which will have a far-reaching effect on the prosperity of the Colony. Mention can only be made of interesting sylvicultural experiments and sowing and planting work; of investigations in connexion with forest soils in collaboration with Prof. Hardy, of the Soil Department of the Imperial College of Tropical Agriculture; and finally, in collaboration with the Trinidad Government Railway, a beginning has been made with wood preservation experiments in connexion with the treatment of mora sleepers. The administrators of the Colony are to be congratulated on the marked progress which their Forest Department has achieved in the past few years.

In Leaflet No. 4 of the Forest Department, Mr. R. C. Marshall deals with the "Forest Trees of Trinidad and Tobago, with Special Reference to their Timbers". The leaflet gives a reasonably complete list of the more prominent forest trees, stating the size to which various species grow, their relative abundance, and giving in a concise form some information as to the timber they produce. It is not, nor does it purpose to be, a complete list of all forest tree species. As noted above, there are 600,000 acres of forest in the Colony. With the exception of the mora forests, which are of special interest through the gregarious habit of mora and the large stocking per acre, practically all the remainder is of a very mixed type such as is common in tropical rain forest, to which category most of the forests belong. Two tabular statements are attached which show the trees by one foot girth

* Trinidad and Tobago: Forest Department. Administration Report of the Conservator for the Year 1930. Pp. 22. (Trinidad: Government Printing Office, Port of Spain, 1931.) 1s.

classes, enumerated on 1000 acres of each type; these tables give some idea of the large number of species which constitute the mixed type of rain forest as compared with the mora forest.

In Leaflet No. 3 of the same Department a note has been drawn up by Mr. R. L. Brooks, deputy conservator of forests, on "An Experiment on Air Seasoning of Native Timbers". Experiments with some of the native woods have been carried out under the supervision of Mr. Brooks, and so far as they have gone apparently justify the hopes of ultimate success. The imports of lumber into the Colony are high, and Mr. Brooks is definitely of opinion that they could be considerably reduced if stocks of seasoned local timber were made available.

Electrical Heresies

IN *Stanford University Publications*, University Series, Mathematics and Astronomy, vol. 2, No. 1, Fernando Sanford, emeritus professor of physics, discusses terrestrial electricity and related topics. The volume, of 208 pages, is well produced and interestingly written; but it would form a very unsafe guide to knowledge. The author propounds views that he recognises as being very heretical, and bound to meet with a hostile reception; but it would be mistaken to be disarmed by his candour in this respect. His cardinal heresy is that "absolute electrical neutrality is unknown upon the earth, and could not be recognised if it were observed" (p. 71).

Prof. Sanford supposes that the ratio of the numbers of protons and electrons may be variable within wide limits upon different planets. In particular, he believes that the sun and earth possess large negative charges—large enough, in the case of the earth, to explain the magnetic field as a result of the daily rotation of the charge. He is aware of the familiar argument—simplest in the case of the sun—that the charge would be expelled by mutual repulsion and the outflow of electrons from the ionised solar atmosphere; but he denies that the electric charge upon a conductor exerts an outward pull upon the atoms of the conductor (though the experiment of an expanding charged soap-bubble would seem to indicate that they do), and that free electrons are held to the sun by gravitation alone. He asserts that electrons are apparently held to conductors by the pressure of the surrounding ether, which can sustain very great charges upon bodies. His positive arguments for the existence of a large solar charge are based on the supposed necessity for considerable charge-densities to explain the magnetism of sunspots, and also of the sun as a whole; also upon the electron gas theory of the solar corona, and on the supposed electrical repulsion of comets' tails—all of them being highly debatable matters, certainly not yet explained according to the generally accepted laws, but very unsuitable as foundations for a striking break-away from these laws.

Further, Prof. Sanford suggests that electrical repulsions between the sun and planets may produce planetary perturbations (particularly for Mercury), and that the daily variation of the charge induced upon the earth by the sun can be detected. His interpretation of his observations on this point is unlikely to gain favour, but the observations themselves might usefully be checked by other observers. Later chapters of the book deal with the electrostatic field of the earth, earth-currents and magnetic variations, magnetic storms and solar activity, magnetic and electric influence of the moon, and barometric pressure and the earth's electric charge; to the reviewer they appear to abound with unlikely hypotheses.

International Congress of Prehistoric and Protohistoric Sciences

A PRELIMINARY outline of the arrangements for the First International Congress of Prehistoric and Protohistoric Sciences, which is to be held in London, has been issued, and it is announced that in order to meet the convenience of foreign delegates the date of meeting will be Aug. 1–6, instead of July 25–30, originally arranged. The first meeting will be held on the afternoon of Aug. 1, and formal meetings will be continued during the week. The following week will be devoted to excursions to places of archæological interest. The Congress will meet under the presidency of Sir Charles Peers, Mr. R. Holland-Martin will act as treasurer, and the general secretaries are Prof. A. W. Brøgger and Prof. J. L. Myres. These appointments were made at the first meeting of the permanent council held in Paris in October last.

In accordance with a further decision of the permanent council, the work of the Congress will be divided into sections, arranged according to practical requirements rather than on strictly scientific lines. A classification of subject matter has been made for the first Congress, on the understanding that future division will be considered at the Congress. The following is the list of sections, with the names of the British archæologists who have been invited to act as presidents: Human Palæontology, the Origin and Evolution of Prehistoric Man (Sir Arthur Smith Woodward); Palæolithic and Mesolithic Periods (Mr. Reginald Smith); The Neolithic, Bronze, and Iron Ages in the Ancient World (Prof. H. J. Fleure, Prof. J. L. Myres, Mr. Sydney Smith); The Neolithic, Bronze, and Iron Ages outside the Ancient World (Dr. H. S. Harrison and Prof. C. G. Seligman); The Passage from Prehistory to History (Mr. E. T. Leeds).

A number of questions has been placed on the agenda, although it is understood that communications on other matters may be offered, provided they come within the limits imposed by the statutes. Among the subjects specifically mentioned are the present state of our knowledge of fossil man, discoveries of human industries in the drift and the loess, the mesolithic question, the megalithic monuments, the problems of the copper and early bronze ages in western Europe, the origin of Mediterranean civilisations, the oriental basis of Ægean chronology, Mediterranean contacts of the west European cultures of late bronze age and Hallstadt types, the Continental sources of racial and industrial types among the Anglo-Saxons, the origin and chronology of the Viking movements. Communications must be sent to the Secretary of the British Organising Committee, Society of Antiquaries, Burlington House, Piccadilly, London, W.1, before May 1, 1932.

Excursions have been arranged, to follow the Congress. They begin on Aug. 6, when those joining will be divided into two parties, of which one will stay at Oxford until Aug. 9, visiting the Rollright Stones, Wayland's Smithy, Uffington, etc., as well as the Ashmolean and Pitt-Rivers Museums. The second party will stay at Cambridge until Aug. 9,

visiting Ipswich, Bramford, and Ely on one of the intervening days, and then proceeding to Oxford, where, after this party has inspected the Ashmolean and Pitt-Rivers Museums, the two parties will join to visit Salisbury and Devizes, returning to London on Aug. 11. An extended excursion, to take in the west of England, and lasting from Aug. 11 until Aug. 15, will be arranged for those who desire; or as alternatives, arrangements will be made for a visit to Ireland, to include Tara, New Grange, and Monasterboice; or to Scotland, to include inspection of the Scottish National Museum and prehistoric sites in the neighbourhood of Edinburgh.

The subscription to the Congress is £1 for members and 10*s*. for associates. Subscriptions should be sent to the treasurer of the Congress, at the Society of Antiquaries, Burlington House, Piccadilly, London, W.

University and Educational Intelligence

CAMBRIDGE.—The following grants have been made from the Worts Fund: £65 to L. S. B. Leakey (St. John's College) for the continuation of archæological and anthropological work in East Africa, £50 to A. Stephenson (St. Catharine's College) towards the expense of publication of the results of the British Arctic Air Route Expedition, £30 to R. B. Roberts (Emmanuel College) and W. V. Lewis (Gonville and Caius College) for cartographical work in Iceland, £30 to R. M. Jackson (St. John's College) towards the expenses of a geographical expedition to Spitsbergen, £25 to E. H. F. Baldwin (St. John's College) for biochemical research at Tamaris, £25 each to P. W. Richards (Trinity College) and P. M. Synge (Corpus Christi College) for botanical research in Sarawak, £20 to S. R. Nockolds (Trinity College) for geological research at Carlingford.

The following have been elected to fellowships at King's College: Mr. L. Bairstow, scholar, who was placed in Class I. Part I. 1927 and in Class I. Part II. 1928 of the natural sciences tripos, as S. H. Ehrman fellow; Dr. H. C. Darby, scholar of St. Catharine's College, University lecturer in the faculty of geography, who was placed in Class I. Part I. 1926 and in Class I. Part II. 1928 of the geographical tripos.

EDINBURGH.—The Senate has resolved to offer the honorary degree of LL.D. to the following, among others: Prof. C. Vernon Boys; Mr. David Middleton Greig, Royal College of Surgeons, Edinburgh; Dr. R. Stewart MacDougall, formerly reader and Steven lecturer in agricultural and forest entomology in the University of Edinburgh; His Excellency Andrew Mellon, United States Ambassador, London; Prof. Arthur Robinson, emeritus professor of anatomy in the University of Edinburgh; the Right Hon. Sir Archibald Sinclair, Secretary of State for Scotland; and Sir Josiah Stamp.

LEEDS.—Prof. J. W. Harvey, at present professor of philosophy in the University of Durham (Armstrong College), has been appointed professor of philosophy, in succession to Prof. C. M. Gillespie, who retires at the end of the present session. Prof. Harvey was educated at Bootham School, York, at Rugby, and at Balliol College, Oxford. He took a first class in classical honour moderations in 1909 and a first class in the final Lit. Hum., 1911. He was lecturer in philosophy in the University of Birmingham from 1912 until 1927, when he was elected to the chair of philosophy at Armstrong College.

LIVERPOOL.—At the meeting of Council on March 13 it was agreed to confer the honorary degrees of M.Eng. and M.Sc., on July 2, on Mr. H. H. Harrison and Mr. W. Horton respectively. Mr. Harrison has published works on steam turbines, boiler feed injectors, and the historical basis of modern telegraph printing. Mr. Horton has been honorary lecturer in plant histology in the University during the past ten years, and has distinguished himself by his investigations on the technical methods of histology and, in particular, by his work on the preparation of knife edges and the critical angles in the sectioning of waxes.

Prof. Herbert E. Roaf, professor of physiology in the London Medical School, has accepted the George Holt chair of physiology in the University as from Oct. 1, in succession to Prof. J. S. Macdonald, who retires at the end of the present session. Prof. Roaf was in succession Johnston colonial fellow, assistant lecturer in physiology, and lecturer in chemical physiology in the University of Liverpool. From 1911 until 1920 he was lecturer in physiology at St. Mary's Hospital Medical School, London.

PROF. A. H. STURTEVANT, professor of genetics at the California Institute of Technology, will lecture at the University of Birmingham during the autumn term of this year. He will be in residence at the University of Leeds on Jan. 5–March 18, 1933, and afterwards proceed to Armstrong College, Newcastle. The lectures have been arranged in connexion with the scheme of the Carnegie Endowment for Industrial Peace, by which certain American professors will spend a year visiting universities in Great Britain.

THE directors of higher education from a number of different countries have just met, for the first time, at the International Institute of Intellectual Co-operation for the purpose of discussing various questions of great importance in the organisation and functioning of their university systems. The following were present: M. Jacques Cavalier (France), M. Ugo Frascharelli (Italy), Sir Frank Heath (British Empire), Prof. Zoltan de Magyary (Hungary), Prof. Werner Richter (Germany), and Dr. Horatio Krans (American University Union in Europe, observer). The committee drew up a comprehensive programme for future work, envisaging, more particularly, agreements concerning university exchanges and the overcrowding of universities and of the liberal professions.

THE Ministry of Agriculture and Fisheries is offering five senior scholarships tenable at agricultural colleges or university departments of agriculture for diploma or degree courses in an agricultural subject, and 130 junior scholarships (including 10 extended junior awards for those who have already held junior scholarships) tenable at farm institutes for courses in agriculture, horticulture, dairying, or poultry husbandry. The awards are confined to sons or daughters of agricultural workers and *bona fide* workers in agriculture. Forms of application and other information may be obtained from the Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1, or from the offices of county councils. The latest date for receiving applications is April 30.

A LIMITED number of fellowships are being offered by the Salters' Institute of Industrial Chemistry to chemists of post-graduate standing. The object of the fellowships is to afford additional and special training preparatory to a career in industrial chemistry. The normal value of each fellowship is from £250 to £300. The Institute also offers a limited number of grants-in-aid to young men or women, not under seventeen years of age, employed in chemical works in or near London, who desire to extend their education for a career in chemical industry. Applications for the fellowships and grants-in-aid must be sent not later than May 1 to the Director, Salters' Institute, Salters' Hall, St. Swithin's Lane, E.C.4.

Calendar of Geographical Exploration

March 28, 1907.—A Tragic Journey in Greenland

L. Mylius-Erichsen, with Capts. Koch and Hagen, an educated Eskimo, Bronlund, and two others, left their winter quarters in Danmarkhaven, Greenland, lat. 75° 43′ N. The expedition had set out in June 1906, and the ship remained at Danmarkhaven for two years, while systematic observations were kept up at the base and the work of exploring to the north was carried on by sledge. Mylius-Erichsen and his party reached the eastern extremity of Greenland, 81° 29′ N., charting the coast as they went. There they divided; Koch and two others reached Cape Bridgman in 83° 29′ N., thus linking up with Peary's 1900 expedition, and returned safely. Erichsen, with Hagen and Bronlund, followed the coast westward into the deep inlet now known as Danmark Fjord. Keeping to the coast, they entered Independence Bay and pushed on to Cape Glacier in 82° N., 35° W., on June 14, 1907. Here they were held by the softness of the snow all summer, and then time was lost on a drifting floe in an effort to cross Danmark Fjord. The only chance of escape was to travel southward over the inland ice and so cut off the eastern horn of Greenland, which the expedition had discovered. They succeeded in face of incredible difficulties in marching 160 miles in 20 days, but first Hagen and then Erichsen died, only Bronlund reaching the supplies left on Lambert Island on the northern journey. But Bronlund was worn out, and, after recording the journey in his diary, died alone in the Arctic night. His diary was discovered by Koch in the following year, and that of Mylius-Erichsen by Mikkelsen in 1910.

April 1, 1791.—Vancouver's Surveys

George Vancouver, with two ships, the *Discovery* and the *Chatham*, sailed from Falmouth. Vancouver had sailed as a midshipman under Cook on his last voyage, and he carried out his work of survey with remarkable thoroughness, being much helped by the fine quality of his officers. On Sept. 26 the Australian coast was sighted and King George's Sound discovered. The northern coasts of New Zealand were surveyed to supplement the work of Cook, and the Chatham group was discovered. Vancouver then proceeded to the Strait of Juan de Fuca, which Meares had considered to be the portal to an inland sea occupying much of the continent of North America and thus making possible easy communication between the Pacific and Hudson Bay. Vancouver meticulously surveyed the labyrinth of channels, determined to leave unexplored no portion of the coast-line which might conceal a possible outlet to the Atlantic: he thus proved that no strait leading across to Hudson Bay could exist in these latitudes. The Columbia River was explored for 84 miles from its mouth. The *Discovery* arrived in the Thames on Oct. 20, 1795, after her four and a half years' voyage, during which only one man of the crews of the two vessels died of disease. This arduous, prolonged, and detailed survey of the western coast of America is one of the most remarkable feats of exploration. It attracted little attention at the time, partly because it was scientific rather than spectacular in character, and partly because Vancouver sought no publicity.

April 2, 1906.—Archæology of Central Asia

Sir Aurel Stein started from Srinagar on the second of the three great journeys which have revealed so much of the ancient history of Central Asia. Though the main objects of these expeditions were archæological, Stein took with him trained surveyors who recorded topographical details with great accuracy. His 1906–8 expedition surveyed the region between Yarkand and the Nan Shan range, and extended his archæological work from Khotan and the Takla Makan (1900–1) to the Lob Nor region and eastwards to China. The third journey covered the whole region between the Tian Shan on the north and the Kuen Lun on the south, extending from the Pamirs to China. Stein has supplemented his classic memoirs on the early history of Chinese Turkestan and Kansu by a series of maps and a geographical memoir.

ERRATUM.—Under date "March 14, 1864", for "Sir S. W. Butler" read "Sir Samuel Baker".

Societies and Academies

LONDON

Geological Society, Jan. 27.—G. M. Stockley: The geology of the Ruhuhu coalfields, Tanganyika Territory; with a report on some fossil plants from the Karroo beds in the Ruhuhu River depression, by **J. Walton.** The area, which is occupied by Karroo rocks, forms a depression between the mountains which lie to the north and south; these are composed of gneisses and other rocks of the primitive system, which are brought into juxtaposition with the Karroo rocks by faults of considerable magnitude. The rocks of the primitive system fall into three groups: (*a*) highly altered felsitic and acid volcanic rocks; (*b*) metamorphosed sedimentary rocks, consisting of quartzites, marbles, ophicalcites, phyllites, and mica-schists; (*c*) gneisses and granulites.—**L. R. Cox:** Lamellibranchia from the Karroo Beds of the Ruhuhu coalfields, Tanganyika Territory. Five species, all referable to the genus *Palæomutela* Amalitsky, are recorded from the lower horizon. Amalitsky's conclusion that the Lower Beaufort mollusca are in most cases identical with species found in the Permian of the Oka-Volga basin and other districts of Russia receives support from the material now studied, although it is considered that the fourteen species recognised by him in his South African material (which has been re-examined) should be reduced to five or six. The upper horizon has yielded numerous shells belonging to a new species of the genus *Unio*; *Unio* has previously been recorded from about the same horizon in North America (several species) and the Dolomites (one species), but not from older rocks.—**S. H. Haughton:** On a collection of Karroo vertebrates from Tanganyika Territory. The fauna of the Lower Bone Bed, containing Pareiasuria, Dicynodontia, Endiothodontia, and Gorgonopsia, and including new genera and species, is closely allied to that of the Lower Beaufort beds of South Africa, and the horizon is considered homotaxial with the middle part of the Lower Beaufort beds and the equivalent of the upper bone horizon of the Chiweta beds of Nyasaland (Upper Permian). The Upper Bone Bed displays a mingling of Anomodontia with Diapsida (Thecodontia and Theropoda). The Thecodontia are distinct from any known form, but the fauna as a whole shows certain similarities to that of the Rio do Rasto beds of Brazil and the Maleri Stage of India. The conclusion is reached that the beds are probably homotaxial with the non-reptile-bearing Molteno Beds of South Africa (Upper Triassic).

Institute of Metals, March 10.—G. D. Bengough and L. Whitby: Magnesium alloy protection by selenium and other coating processes. These films confer considerable resistance to the corrosive action of sea-

water spray. They are normally produced by immersion for a few minutes in a bath containing selenious acid at laboratory temperature, but may also be produced by rubbing the alloy with porous material dipped in the bath. The film has the property of self-healing to a limited extent, especially when immersed in stagnant sea-water; it is only a few thousandths of a millimetre thick.—**Marie L. V. Gayler** and **G. D. Preston**: The age-hardening of some aluminium alloys of high purity. Age-hardening of a duralumin at room temperature and at 200° C. is due to some process, as yet undefined, which takes place prior to actual precipitation of $CuAl_2$ or Mg_2Si from the aluminium lattice. In conjunction with existing equilibrium data, it is suggested that Mg_2Si as well as $CuAl_2$ plays an important part in the process of age-hardening.—**C. F. Elam**: Some bronze specimens from the royal graves at Ur. Some of the objects found by Mr. C. Leonard Woolley had been cast; others showed signs of subsequent working and annealing.—**W. H. J. Vernon**: The 'fogging' of nickel. The effect is attributed mainly to the catalytic oxidation of small amounts of atmospheric sulphur dioxide; suspended sulphates play a minor part. There is a critical relative humidity, below which the metal may be exposed, apparently indefinitely, without action taking place, and above which fogging readily occurs. Film formation is approximately halved when light is completely excluded. The formation of the primary film may be largely suppressed by pre-exposure of the metal to an atmosphere containing traces of hydrogen sulphide. Fogging may also be inhibited by alloying the nickel with chromium, or by covering the surface with a film of lanoline.—**H. J. Gough** and **H. L. Cox**: The behaviour of single crystals of bismuth subjected to alternating torsional stresses. Throughout the tests no slip bands were observed. In the early stages of the tests numerous bands were produced parallel to the twinning planes, and finally cleavage cracking occurred. The production of twin bands appeared to depend on the sheer stresses on the twinning plane. On the basis of minimum energy, there is no reason to associate any type of movement with stresses tending to cause this movement by the shortest geometrical path, and the process of twinning may be due to stresses which at first sight appear to be incapable of affecting the process.—**P. Saldau** and **M. Zamatorin**: The solubility of aluminium in magnesium in the solid state at different temperatures. The solubility of aluminium in magnesium of 99·68 per cent purity has been determined at temperatures up to 420° C. The solubility limit at room temperature is 6·08 per cent aluminium by weight, and this is maintained unchanged until 300° C., after which a rapid increase occurs, the solubility line passing through 10·9 per cent by weight of aluminium at 400° C., and intersecting the eutectic line (436° C.) at the point corresponding with 12·6 per cent aluminium by weight.—**H. O'Neill** and **H. Greenwood**: Observations on the pressure of fluidity of annealed metals. The pressure of fluidity at room temperatures has been designated as the stress at which a loaded rigid punch continuously penetrates a block of ductile metal. Examination of such a partly-punched specimen by hardness tests after sectioning, reveals that the most highly strained regions have a (Meyer) ball index value of $n = 2·0$ and a resistance to indentation equal to the pressure of fluidity. The value of the latter for a given specimen can therefore be determined by a cone or ball test after cold-working the material to the greatest possible extent by rolling. The suggestion is made that the condition of 'critical plasticity' observed by Tresca, Kick, Coe, and others in the course of compression tests, corresponds with the condition of 'necking' in tensile tests.—**W. Rosenhain**: The testing of castings. Ideal methods of non-destructive testing being as yet unavailable, the application of the usual mechanical tests to castings is considered. The author favours the adoption of a separately cast test-piece, the use of small samples cut from actual castings being reserved for investigatory purposes. The use of chill-cast and sand-cast test-bars is discussed with special reference to the forthcoming adoption of a standardised sand-cast test-bar for the light alloys of aluminium. Reference is also made to the difficulty of determining small percentage elongations; and the practice followed in cast iron testing of using bending tests, in which deflection is measured as a means of testing ductility, is described.

PARIS

Academy of Sciences, Feb. 8.—**L. Lecornu** and **Charles Richet**: The rheometric disc, a simple apparatus for measuring the velocity of (ocean) currents.—**L. Cayeux**: The magnesium deposits of the Paris basin, regarded in their relations with breaks of equilibrium of the sea floor.—**William Bowie**: A possible cause of earthquakes not evident at the surface of the globe.—**Maurice Gignoux** was elected *Correspondant* for the Section of Mineralogy.—**Paul Delens**: The spherical representation of congruences.—**Paul Mentré**: The projective application of the tetrahedral harmonic complex on the non-special linear complex.—**J. Delsarte**: A matrix equation.—**Jacques Devisme**: Some partial differential equations.—**Mandelbrojt**: The rôle of the Borel monogene functions in the theory of the Dirichlet's series.—**Davin**: The elastic and plastic state of an indefinite body in two dimensions perforated by a circular hole and under the action of a uniform force at infinity.—**Enrico Volterra**: The propagation from ram strokes through a node of a network of mains.—**Thadée Banachiewicz**: The determination of the vectorial constants of the orbit from two heliocentric points of a star.—**Benjamin Jekhowsky**: The angle S which determines the orientation j of the grand circle of asteroids.—**Ch. Volet**: The calculation of parabolic double stars.—**D. Wolkowitsch**: Applications of the ellipsoid of inertia.—**E. G. Barrillon**: The congruence of straight lines of thrust.—**N. Gunther**: The problem of cooling.—**Pierre Vernotte**: The propagation of a velocity of heating in a metallic bar.—**M. Pauthenier** and **Mme. M. Moreau-Hanot**: The experimental control of the movement of small metallic spheres in an ionised electrical field.—**G. Nadjakoff**: The formulæ of the three classes of torsion electrometers.—**P. Geoffroy** and **T. Koulomzine**: Contribution to the geological study of the massifs known as primary of the Middle Chelif (Algeria).—**Paul Fallot**: The *accidents* of the Rif chain along the Xauen transversal.—**Henri Erhardt**: The nature and the genesis of the palæo-soils of the old lœss of Alsace.—**Gandillon**: Project for utilising the Lake Maracaibo region in Venezuela. It is proposed to divert two small streams now flowing into the lake into the sea, close the neck with a narrow barrage, and after lowering the level of the lake by evaporation, to develop water power by allowing the sea to flow in.—**N. Arabu**: An attempt at a new classification of the ammonoids of the Trias.—**Joseph Lefèvre**: A case of unilateral heredity presented by wheat.—**P. Vignon**: The posterior wing of the Coleoptera.—**Mme. L. Randoin** and **Mlle. A. Michaux**: The variations, during acute experimental scurvy, of the quantities of sodium and potassium eliminated by the kidneys and present in the blood serum and total blood.—**Paul Portier** and **Frank Emmanuel**: The absorption of heat radiations by the wings of Lepidoptera.—**Paul Durand**: The Weil-Félix reaction in

eruptive fever.—**D. Santenoise**: The hormonal individuality of vagotonin. The author compares the properties, chemical and physiological, of vagotonin, a hormone which can be isolated from the pancreas, and insulin, and concludes that insulin and vagotonin are distinct. Both hormones are secreted by the liver. —**M. Loeper** and **A. Mougeot**: The lipo-selection of cations, a new method in experimental hydrology.

ROME

Royal National Academy of the Lincei: Communications received during the vacation, 1931. — **S. Pincherle**: A special linear operator (2).—**E. Pinte**: Developes of curves in Hilbertian space.—**L. Fantappiè**: The general expression of linear analytic functionals. —**M. Ghermanesco**: The n-metaharmonic functions of p variables.—**B. de Finetti**: The characteristic functions of instantaneous laws endowed with exceptional values.—**G. Lampariello**: Elastic waves in anisotropic media.—**G. Krall**: Adiabatic influences of the tides in the Keplerian motion of two gyroscopic celestial bodies.—**A. Weinstein**: The movement of a fluid through a permeable barrage.— **A. Rosenblatt**: The stability of the laminar movements of viscous liquids (3). Convergence of the algorithm.—**G. Righini**: The profile of the line λ5183 of magnesium in the solar spectrum. The author's earlier determinations are upheld against the criticisms of Plaskett.—**V. Ricca**: The Raman spectrum of sulphuric acid and the action on it of an electric field. The phenomena arising from the action of an electric field on the Raman spectrum of sulphuric acid are explainable by supposing that the effects on the non-modified lines of the spectrum are due to the motion of the hydrogen ions in the direction of the field, and those on the Raman lines partly to the same cause and partly to the orienting action of the field on the ions.—**Leo Pincherle**: Hull's magnetron. A method is given for the theoretical determination of the wave-length of the high-frequency oscillations (electronic oscillations) emitted by Hull's magnetron in the case when the magnetic field is parallel to the axis of the diode.—**V. Polara**: The Raman spectrum in sugar solutions. The Raman spectrum of saccharose exhibits five of the seven lines of the glycerol spectrum and four lines of alcohol spectra. It displays, moreover, the various types of linking which, in the molecular structure of compounds of the aliphatic series, are considered to correspond with particular Raman lines.—**G. Scagliarini** and **P. Pratesi**: Volumetric determination of vanadium and molybdenum. Electrochemical considerations on the reducing activity of metallic copper. It was shown previously that, in presence of sulphuric acid, copper quantitatively reduces Fe^{III} to Fe^{II} and U^{VI} to U^{IV}, but is without action on Ti^{IV} and Cr^{III}. It is now found that, under similar conditions, vanadium and molybdenum undergo quantitative reduction in accordance with the schemes: $V^{V} + Cu = V^{III} + Cu^{II}$ and $2Mo^{VI} + Cu = 2Mo^{V} + Cu^{II}$.—**V. Caglioti** and **P. Agostini**: The use of X-rays in quantitative analysis.—**V. Famiani**: Contribution to the knowledge of the nutritive values of certain cereals. Tallarico has shown recently that small-corned grain has a greater nutritional value for turkeys than grain with large corns. This result is now confirmed by the data yielded by experiments on growing albino rats fed with wheat, maize, or barley. —**Giambattista Dal Piaz**: Course of the lines of dislocation accompanying the intrusive masses of Mounts Croce, Ivigna, and Bressanone in the Upper Adige. Tectonic peculiarities of this region indicate that the vast intrusive arch of the Croce-Ivigna-Bressanone-Pusteria mountain range, the tertiary and non-Palæozoic age of which has been confirmed by recent investigations, is included in the Dinaric series.—**G. Mezzadroli** and **E. Vareton**: Comparison between the actions exerted on the development of silkworms by a simple, open oscillating circuit and by one in syntony with a radio-oscillator for ultra-short waves. In comparison with the effect of a simple, open metallic circuit, that of an oscillating circuit syntonised with a radio-oscillator results in more rapid development of silkworms, which grow larger and more resistant to disease, form cocoons sooner, and give a greater yield of cocoons.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, **17**, Nov. 15). —**George H. Parker** and **Virginia L. Paine**: Progressive degeneration of the lateral-line nerve in the catfish. The nerves of several fish were cut behind the gills and the fish killed at regular intervals. Secondary degeneration in the myelin sheath moves peripherally and slowly over the nerve. The degenerative wave seems to be a progressive metabolic change due possibly to the cessation of supply of a substance from the nucleated region of the neurone.—**T. W. Torrey**: The relation of taste-buds to their nerve-fibres. Taste-buds on the barbels of the catfish disappear within eleven days of cutting their nerve supply. Degeneration takes only one day. Lowering the temperature postpones onset of degeneration but does not affect the time required for degeneration. A chemical material is suggested as necessary for the maintenance of taste-buds and for the maintenance of the nerve itself.—**G. H. Parker**: (1) The colour changes in the sea-urchin *Arbacia*. *A. pustulosa* was reported by Uexküll to be brown in darkness and deep black in the light. No colour change has been detected in the allied form *A. punctulata*. The general conclusion is that chromatophores with their associated colour changes occur in the animal kingdom only when eyes and central nervous organs are sufficiently developed to enable an organism to respond to a luminous environment.—(2) Effects of acetyl choline on chromatophores. Has slight effect on a common killifish, but none on a spotted frog.—**Wilder D. Bancroft** and **John E. Rutzler, jr.**: Reversible coagulation in living tissue (8). Bulbocapnine is an agglomerating agent for protein sols both *in vitro* and *in vivo*.—**Karl Sax**: Crossing-over and mutation. Work on *Drosophila* shows a high correlation between crossing-over and mutation, maximum frequency of both occurring at the same region in the chromosome. It is suggested that mutations are produced by crossing-over, the most probable agency being unequal crossing-over; natural selection tends to eliminate unequal crossing-over, and this decreases rate of mutation.—**H. Beckett Lang** and **John A. Paterson**: A preliminary report on functional psychoses. A report of cases of dementia præcox, manic depressive and epileptic psychoses treated on the lines of suggestions made by Prof. Bancroft and his collaborators that these conditions are due to over-peptisation or agglomeration of nerve colloids. The general conclusions from the effects of treatment with sodium amytal and sodium rhodanate are that these psychoses are accompanied by changes in the nerve colloids, and that these drugs afford a method of observing the effects of known methods of treatment.—**William T. Richards**: The heating of liquids by the absorption of sound, and its relation to the energy of intense high-frequency sound waves. Dielectric loss in the liquid due to the oscillating electric field producing the sound waves, and contact with the oil transmitting the sound waves and with the containing vessel, are important sources of heat. An apparatus designed to avoid these difficulties gave

for 25 c.c. of water a heating effect of about 2·5° C. per minute, corresponding to 28 cal. min.$^{-1}$ cm.$^{-2}$ for an input of 2·5 kw. Bigger effects quoted by other investigators are due mainly to dielectric loss and oil heating.—**W. H. Zachariasen**: The crystal lattice of calcium metaborate, CaB_2O_4. The oscillating crystal method was used. A feature of the structure is the endless strings of BO_3 groups parallel to the *c*-axis.—**Roy J. Kennedy** and **Edward M. Thorndike**: A search for an electrostatic analogue to the gravitational red shift. An electrodeless discharge in mercury vapour, which could be submitted to an electrostatic field, was examined at zero potential and at potentials of about 50,000 volts above or below zero, by a quartz interferometer maintained at zero potential. No significant change of frequency was observed.

Forthcoming Events

TUESDAY, MARCH 29

ITALIAN SOCIETY OF EXPERIMENTAL BIOLOGY (Annual Meeting) (at Institute of Physiology, Turin University).—Subjects for discussion:—The Carbonic Anhydride Equilibrium in the Blood, introduced by Prof. R. Margaria, and Pharmacological Action and Radioactivity, introduced by A. Benedicenti.

WEDNESDAY, MARCH 30

ITALIAN SOCIETY OF EXPERIMENTAL BIOLOGY (Annual Meeting) (at Institute of Physiology, Turin University) —*continued.*

THURSDAY, MARCH 31

ROYAL AERONAUTICAL SOCIETY (Annual General Meeting), at 6.30.

FRIDAY, APRIL 1

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (Annual General Meeting) (at Engineers' Club, Manchester), at 7.—F. J. Slee: Laboratory Tests of Lubricants and their Relation to Engine Tests.

Official Publications Received

BRITISH

Transactions of the Institute of Marine Engineers, Incorporated. Session 1932, Vol. 44, No. 1, February. Pp. 56+xxxiv. (London.)

Liverpool Observatory and Tidal Institute. Annual Report, 1931. Pp. 15. (Liverpool.)

Reports of the Imperial Economic Conference. Twentieth Report: The Wheat Situation, 1931. Pp. 121. (London: H.M. Stationery Office.) 6*d.* net.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1300: Collected Reports on British High Speed Aircraft for the 1927 Schneider Trophy Contest. With an Introduction by W. L. Cowley. Pp. iv+372+232 plates. (London: H.M. Stationery Office.) 20*s.* net.

Journal of the Chemical Society. February. Pp. vi+337-725+viii. (London: Chemical Society.)

Proceedings of the Royal Irish Academy. Vol. 40, Section B, No. 13: The Nature of the Metabolic Regulation of the Body Temperature and its Relation to Temperature Sensations. By J. M. O'Connor. Pp. 175-193. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d.*

The Economic Proceedings of the Royal Dublin Society. Vol. 2, Nos. 27-28: Influences of Heating and Agitating Milk before Separation on the Fat Loss in the Skim Milk, by J. Lyons and W. Finlay; The Accuracy of Fat Determinations in Buttermilk, and the Effect thereon of the Presence of Lecithin, by J. Lyons and W. Finlay. Pp. 423-459. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 2*s.*

Committee of the Privy Council for Medical Research. Report of the Medical Research Council for the Year 1930-1931. (Cmd. 4008.) Pp. 153. (London: H.M. Stationery Office.) 2*s.* 6*d.* net.

Journal of the Royal Statistical Society. New Series, Vol. 95, Part 1. Pp. viii+186. (London: Royal Statistical Society.) 7*s.* 6*d.*

The Proceedings of the Physical Society. Vol. 44, Part 2, No. 242, March 1. Pp. viii+115-229. (London: Physical Society.) 7*s.* net.

Transactions of the Hull Geological Society. Edited by T. Sheppard. Vol. 7, Part 3, 1930-1931. Pp. 77-103. (Hull: A. Brown and Sons, Ltd.) 5*s.*

The Quarterly Journal of the Geological Society of London. Vol. 88, Part 1, No. 349, February 25th. Pp. 111. (London: Longmans, Green and Co., Ltd.) 7*s.* 6*d.*

Researches published from the Wards and Laboratories of the London Hospital during 1931. 32 papers. (London: H. K. Lewis and Co., Ltd.) 7*s.* 6*d.* net.

The Journal of the Royal Technical College: being a Record of some of the Research Work carried out in the College by the Staff and Senior Students. Vol. 2, Part 4, January. Pp. iv+571-710. (Glasgow: Robert Anderson and Sons, Ltd.) 10*s.* 6*d.*

Navy (Health). Statistical Report of the Health of the Navy for the Year 1930. Pp. 148. (London: H.M. Stationery Office.) 2*s.* 6*d.* net.

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 24: The Preservative Treatment of Fence Posts (with Particular Reference to Western Australia). By J. E. Cummins. Pp. 34. (Melbourne: H. J. Green.)

The Pasteur Institute of Southern India, Coonoor. The Annual Report of the Director for the Year ending 31st December 1930, together with the Twenty-fourth Annual Report of the Central Committee of the Association for the Year ending 31st March 1931. Pp. 76. (Madras: Methodist Publishing House.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1414 (Ae. 535—T. 3035): Drag and Interference of a Nacelle when Installed on the Upper Surface of a Wing. By W. G. A. Perring and C. Callen. Pp. 24+13 plates. 1*s.* 3*d.* net. No. 1430 (T. 3169): Simple Tilting Manometer for Rapid Reading. By Dr. James Small. Pp. 4+3 plates. 6*d.* net. No. 1427 (T. 3047, a and b): Primary Stresses in the Hull of a Rigid Airship. By L. Chitty and R. V. Southwell. Pp. 41+5 plates. 2*s.* net. (London: H.M. Stationery Office.)

Proceedings of the Royal Society. Series A, Vol. 135, No. A827, March 1. Pp. 282-511. (London: Harrison and Sons, Ltd.) 12*s.*

South Australia: Department of Mines. Mining Review for the Half-Year ended June 30th, 1931. (No. 54.) Pp. 134. Annual Report of the Director of Mines and Government Geologist for 1930. Pp. 8. (Adelaide: Harrison Weir.)

Proceedings of the Prehistoric Society of East Anglia for 1931. Vol. 6. Part 4. Edited by G. Maynard. Pp. xvi+253-385+plates 20-37, (Ipswich: East Anglian Daily Times Co., Ltd.) 15*s.* net.

Transactions of the Optical Society. Vol. 32, 1930-31, No. 4. Pp. iv+129-164. (London: Optical Society.) 10*s.*

FOREIGN

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 8, No. 1, January, Research Papers Nos. 396-406. Pp. 157. (Washington, D.C.: Government Printing Office.) 40 cents.

U.S. Department of the Interior: Office of Education. Bulletin, 1931, No. 20: Biennial Survey of Education in the United States, 1928-1930. Chapter 4: Industrial Education. By Maris M. Proffitt. Pp. 44. 10 cents. Bulletin, 1931, No. 20: Biennial Survey of Education in the United States, 1928-1930. Chapter 20: National Surveys of the Office of Education. By Walton C. John. Pp. 32. 10 cents. Bulletin, 1931, No. 22: Record of Current Educational Publications, July 1—September 30, 1931. Edited by Martha R. McCabe. Pp. v+86. 15 cents. (Washington, D.C.: Government Printing Office.)

Institutul Meteorologic Central al României. Memorii şi Studii, Vol. 1, No. 3: Climat de la Dobroudja et du littoral de la Mer Noire. Par Enric Otetelişanu et Const. A. Dissescou. Pp. 71+15 planches. 200 lei. Date Climatologice, Vol. 1, No. 1: i. Moyennes déduites de la période 1890–1915 de 32 stations de IIme ordre; ii. Moyennes annuelles et mensuelles de pression, température et précipitations atmosphériques, de 14 stations; iii. Moyennes horaires des éléments météorologiques de Bucarest. Recueillies par Const. A. Dissescou. Pp. 128+1 planche. (Bucuresti.)

Union Internationale de Chimie. Table Internationale des poids atomiques: Deuxième rapport de la Commission des poids atomiques, 1932. Pp. 32. (Paris.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 112: Watering and Spacing Experiments with Egyptian Cotton. By Dr. J. Templeton. Pp. 7+6 plates. (Cairo: Government Press.) 2 P.T.

R. Osservatorio Astrofisico di Catania. Annuario 1932. Pp. iv+34. (Catania.)

Abhandlungen der Bayerischen Akademie der Wissenschaften, Mathematisch-naturwissenschaftliche Abteilung, Neue Folge, 8: Theoretische und praktische Untersuchungen über die Bestimmung der Randverdunkelung der Sonne aus aktinischen Energiemessung während einer Sonnenfinsternis. Von Paul Harzer. (Publikation der Sternwarte in Kiel, Nr. 18.) Pp. 60. (München: R. Oldenbourg.)

Beiträge zum Modus der Ossifikationsvorgänge in der Anlage des Extremitätenskelettes bei den Equiden: der Verknöcherungsprozess in der Pferde- und Eselgliedmasse auf Grund röntgenologischer Untersuchungen. Von Max Küpfer. (Denkschriften der Schweizerischen Naturforschenden Gesellschaft, Band 67.) Pp. viii+352+31 Tafeln. (Zürich: Gebrüder Fretz A.G.)

U.S. Department of Agriculture. Technical Bulletin No. 274: Hot Water as an Insecticide for the Japanese Beetle in Soil and its Effect on the Roots of Nursery Plants. By Walter E. Fleming and Francis E. Baker. Pp. 42. (Washington, D.C.: Government Printing Office.) 15 cents.

Proceedings of the American Academy of Arts and Sciences. Vol. 66, No. 11: Bermuda during the Ice Age. By Robert W. Sayles. Pp. 381-468+13 plates. (Boston, Mass.) 2 dollars.

Publications of the Observatory of the University of Michigan. Vol. 4, No. 5: A Study of S Sagittae. By John A. Aldrich. Pp. 75-92. Vol. 4, No. 6: A Device for the Differential Correction of Conditioned Orbits by Leuschner's Method. By Allan D. Maxwell. Pp. 93-99. (Ann Arbor, Mich.)

Publikationer fra det Danske Meteorologiske Institut. Aarbøger. Isforholdene i de Arktiske Have (The State of the Ice in the Arctic Seas), 1931. Pp. 16+5 maps. (København: G. C. E. Gad.)

Government of el 'Iraq. An Inquiry into Land Tenure and related Questions. Proposals for the Initiation of Reform. By Sir Ernest Dowson. Pp. 78+5 plates. (Baghdad; The Ministry of Finance; London: The 'Iraqi Legation.) 3 rupees; 4*s.* 6*d.*

U.S. Department of the Interior: Office of Education. Bulletin, 1931, No. 19: Circular Letters as a Supervisory Agency. By Jessie M. Parker. Pp. v+80. (Washington, D.C.: Government Printing Office.) 15 cents.

Smithsonian Institution: United States National Museum. Bulletin 159: The Birds of the Natuna Islands. By Harry C. Oberholser. Pp. vi+137. (Washington, D.C.: Government Printing Office.) 25 cents.